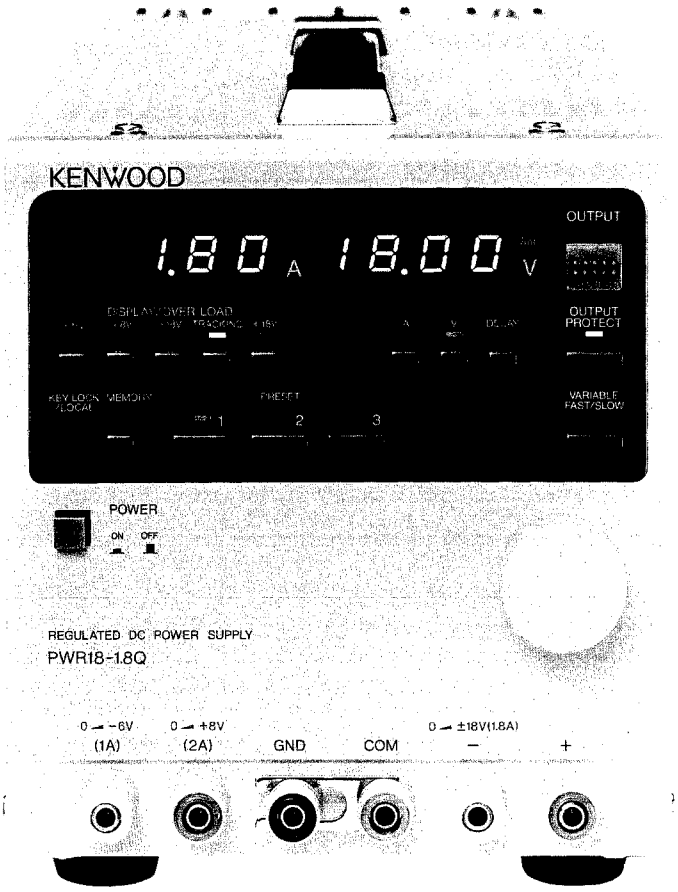
KENWOOD

REGULATED DC POWER SUPPLY

PWR18-1.8Q

SERVICE MANUAL

KENWOOD CORPORATION



WARNING

The following instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than contained in the operating instructions unless you are qualified to do so.

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SPECIFICATIONS

Model	PWR18-1.8Q		
OUTPUT VOLTAGE			
Output voltage	0 to +18V/0 to −18V	0 to +8V	0 to −6V
Setting resolution	10mV		
Max. output voltage	+18V/−18V	+8.0V	−6.0V
Dual tracking	0 to ±18V		
Tracking deviation	±(1%+40mV) of rated voltage		
OUTPUT CURRENT			
Output current	0 to +1.8A/0 to −1.8A	0 to +2A	0 to −1A
Setting resolution	10mA		
Max. output current	+1.8A/−1.8A	+2.0A	−1.0A
Dual tracking	0 to ±1.8A		
Tracking deviation	(2%+40mA) of rated current		
CONSTANT VOLTAGE CHARACTERISTICS			
Input fluctuation (for surge of AC±10%)	1mV		
Load fluctuation (for surge of 0 to 100%)	3mV		
Ripple/noise rms (10Hz to 1MHz)	0.5mV rms		
Ripple peak (p-p)	2.8mV p-p		
Transient response	50μs Typical		
Temperature coefficient	100ppm/°C Typical		
CONSTANT CURRENT CHARACTERISTICS			
Input fluctuation (for surge of AC±10%)	2mA Typical		
Load fluctuation (for surge of 0 to 100%)	10mA Typical		
Ripple/noise rms (10Hz to 1MHz)	2mA rms Typical		
Ripple peak (p-p)	5.6mA p-p Typical		
Temperature coefficient	300ppm/°C Typical		
VOLTMETER			
Display (3-1/2 digit LED)	max. 19.99V, fixed range red LED		
Accuracy (output "ON")	±(0.5% rdg+2 digit) (23°C±5°C, less than 80% RH)		
AMPMETER			
Display (3 digit LED)	max. 9.99A, fixed range red LED		
±Accuracy (output "ON")	(1.0% rdg+2 digit) 23°C±5°C, less than 80% RH		
FUNCTIONS			
Output ON/OFF	ON/OFF switch. However, output cannot be ON when MEMORY ON. Red LED lights up when ON.		
Output protect ON/OFF	Disables the output of unexpected voltage and current in the output mode. This 'PROTECT' function becomes active when a different value is set by one of the PRESET, VARIABLE and TRACKING keys in the output mode. (ON→Red LED active)		
Preset (1,2,3)	3 voltages or currents can be preset as desired. Preset values can be easily checked. Green LED lights up when ON.		

SPECIFICATIONS

Model	PWR18-1.8Q
Memory	Several voltage and current presets can be stored. Red LED lights when ON.
Key Lock	Locks all functions as set. All controls except POWER are disabled. Red LED.
Delay	ON/OFF DELAY of ±18V and +8V/−6V output. Green LED lights up when ON.
V/A	Several voltages and currents can be set. Green LED.
Tracking and V/A display selection	±18V tracking, +18V, −18V, +8V, −6V
OUTPUT	
COM	±18V +8V, −6V COM common
Polarity	COM, positive or negative ground possible
Output terminals	+ (red), − (white), COM (blue), GND (black)
Ground proof voltage	±250V DC
SERIAL OUTPUT	0 to 36V
OPERATION CONDITIONS	
Rated temperature/humidity range	0 to 40°C, 10 to 85% RH
Operation temperature/humidity range	0 to 40°C, 10 to 85% RH
Storage temperature/humidity range	−20 to 65°C, 10 to 85% RH
Cooling mechanism	Natural convection
POWER CONSUMPTION	
VA/W (at AC 100V)	approx. 240VA/213W
INPUT VOLTAGE	
Voltage, Frequency	AC 100V/120V/220V/240V±10% (max. 250V) 50/60Hz Internal switching possible.
DIMENSIONS AND WEIGHT	
Dimensions	width: 138mm height: 147mm depth: 372mm
Max. dimensions	width: 143mm height: 167mm depth: 392mm
Weight	approx. 8.2kg
Accessory items	1 instruction manual 1 power supply cord 2 fuses 1 moduler cable (for remote control)

■ Circuit and ratings are subject to change without notice due to developments in technology.

SAFETY

SAFETY

Before connecting the instrument to a power source, carefully read the following information, then verify that the proper power cord is used and the proper line fuse is installed for power source. If the power cord is not applied for specified voltage, there is always a certain amount of danger from electric shock.

Line voltage

This instrument operates using ac-power input voltages that 100/120/220/240 V at frequencies from 50 Hz to 60 Hz.

Power cord

The ground wire of the 3-wire ac power plug places the chassis and housing of the instrument at earth ground. Do not attempt to defeat the ground wire connection or float the instrument; to do so may pose a great safety hazard. The appropriate power cord is supplied by an option that is specified when the instrument is ordered.
The optional power cords are shown as follows in Fig. 1.

Line fuse

The fuse holder is located inside the instrument and contains the line fuse. Verify that the proper fuse is installed by replacing the line fuse.

Voltage conversion

This instrument may be operated from either a 100 V to 240 V, 50/60 Hz power source. Use the following procedure to change from 100 to 240 volt operation or vice versa.

1. Remove the case. Change the power voltage according to instruction manual.
2. Replace the fuse with a fuse of appropriate value, 3 amp for 100 VAC to 120 VAC operation, 1.5 amp for 220 VAC to 240 VAC operation.
3. When performing the reinsertion of fuse for the voltage conversion, the appropriate power cord should be used. (See Fig. 1.)

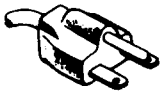
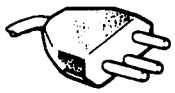
Plug configuration	Power cord and plug type	Factory installed instrument fuse	Line cord plug fuse	Parts No. for power cord set
	North American 120 volt/60 Hz Rated 15 amp (12 amp max; NEC)	3 A, 250 V Slow blow 6 × 30 mm	None	Cord: E30-1951-05
	Universal Europe 220 volt/50 Hz Rated 16 amp	1.5 A, 250 V Slow blow 6 × 30 mm	None	Cord: E30-1952-05
	U.K. 240 volt/50 Hz Rated 13 amp	1.5 A, 250 V Slow blow 6 × 30 mm	0.8 A Type C	Cord: E30-1945-05
	Australian 240 volt/50 Hz Rated 10 amp	1.5 A, 250 V Slow blow 6 × 30 mm	None	Cord: E30-1953-05
	North American 240 volt/60 Hz Rated 15 amp (12 amp max; NEC)	1.5 A, 250 V Slow blow 6 × 30 mm	None	–
	Switzerland 240 volt/50 Hz Rated 10 amp	1.5 A, 250 V Slow blow 6 × 30 mm	None	–

Fig. 1 Power Input Voltage Configuration

CIRCUIT DESCRIPTION

+/− 12 V AND +5 V GENERATOR

AC voltages from the AC Power Transformer T1 are first transformed into +/− DC power by a center-tap type control rectifier and smoother, (D1) and (C1 and C2). The center tap of the transformer is used as a reference. The +/− 12 V is then generated through U1 and U2 circuits after which the +5 V is generated from +12 V through the U3 circuit. The generated +/− 12 V and +5 V are used as control power of the main power source and their reference includes all the references of the center tap. The potentials are directly connected to the COM.

AC POWER SWITCH (K1) AND AC POWER DRIVE (Q5)

The main AC power source, for the power source +18 V output, is input from the AC Power Transformer T1. Two types of potentials, based on references of one tap, become input. As a transfer relay is used in K1, only one potential can be provided for the Rectifier and Smoother. K1 is controlled by Q5 and when Q5 is ON, K1 provides a high voltage to the Rectifier and Smoother. When Q5 is OFF, K1 provides a low voltage to the same.

AC POWER SWITCH (K2) AND AC POWER DRIVE (Q6)

The main AC power source, for the power source −18 V output, is input from the AC Power Transformer T1. The concept here is the same as the +18 V output, except that K1 is replaced by K2 and Q5 is replaced by Q6.

RECTIFIER AND SMOOTHER (D51 AND C51)

AC Power output from K1 becomes transformed into DC power.

RECTIFIER AND SMOOTHER (D52 AND C52)

AC Power output from K2 becomes transformed into DC power.

RECTIFIER AND SMOOTHER (D57 AND C51)

Main AC power for the power source +8 V output becomes input from T1 and transformed into DC power.

RECTIFIER AND SMOOTHER (D58 AND C54)

Main AC power for the power source −6 V output becomes input from T1 and transformed into DC power.

SERIES PASS TRANSISTORS (Q11 AND Q12)

Unstable DC power, output from D51 and C51, are transformed into stable AC power. Transistors (Q11 and Q12) for PNP coupling are connected in series and regulated by signals from amplifiers (Q1 o7 3 and R52).

SERIES PASS TRANSISTORS (Q13 AND Q14)

Unstable DC power, output from D52 and C52, are transformed into stable AC power. Transistors (Q13 and Q14) for NPN coupling are connected in series and regulated by signals from amplifiers (Q2 and R53).

SERIES PASS TRANSISTORS (Q15 AND Q16)

Unstable DC power, output from D57 and C53, are transformed into stable AC power. Transistors (Q15 and Q16) for PNP coupling are connected in series and regulated by signals from amplifiers (Q3 and R54).

SERIES PASS TRANSISTOR (Q17)

Unstable DC power, output from D58 and C54, are transformed into stable AC power. This section is made up of Transistor (Q17) for NPN coupling and regulated by signals from amplifiers (Q4 and R55).

CURRENT DETECTOR (R59) AND VOLTAGE DIVIDER (VR3 AND R63)

Stable DC power output from Q11 is led to the Power ON/OFF [K102 (1/2)] via R59. The electric current input into R59 becomes output as voltage. This voltage input through VR3 and R63 becomes potential divided and in turn input into the Error Current Amplifier (U5a).

CURRENT DETECTOR (R60) AND VOLTAGE DIVIDER (VR4 AND R64)

Stable DC power output from Q13 and Q14 is led to the Power ON/OFF [K102(2/2)] via R60. The electric current input into R60 becomes output as voltage. This voltage input through VR4 and R64 becomes potential divided and in turn input into the Error Current Amplifier (U6a).

CURRENT DETECTOR (R61) AND VOLTAGE DIVIDER (VR5 AND R65)

Stable DC power output from Q15 and 16 is led to the Power ON/OFF [K104 (1/2)] via R61. The electric current input into R61 becomes output as voltage. This voltage input through VR5 and R65 becomes potential divided and in turn input into the Error Current Amplifier (U7a).

CIRCUIT DESCRIPTION

CURRENT DETECTOR (R62) AND VOLTAGE DIVIDER (VR6 AND R66)

Stable DC power output from Q17 is led to the Power ON/OFF [K104 (2/2)] via R62. The electric current input into R62 becomes output as voltage. This voltage input through VR6 and R66 becomes potential divided and in turn input into the Error Current Amplifier (U8a).

POWER ON/OFF [K102 (1/2) AND K102 (2/2)] SWITCHES AND POWER ON/OFF DRIVE (Q101)

Each +18 V and −18 V DC power, output from R59 and R60, passes through the Power ON/OFF switch (K102) and in turn output from the Power Source +18 V and −18 V Output Terminals. K102 (1/2) outputs positive power while K102 (2/2) outputs negative power, both of which use two units of relays each. The ON/OFF of +18 V and −18 V is done simultaneously.

K102 is controlled by the Power Output ON/OFF Drive (Q101).

K102 is ON when Q101 is ON and the power is output. K102 is OFF when Q101 is OFF and no power is output.

POWER OUTPUT ON/OFF SWITCHES [K104 (1/2 AND 2/2)] AND POWER OUTPUT ON/OFF DRIVE (Q102)

Each +8 V and −6 V DC power, output from R61 and R62, passes through the Power ON/OFF switch (K104) and in turn output from the power Source +8 V and −6 V

Output Terminals. K104 (1/2) outputs positive power while K102 (2/2) outputs negative power, both of which use two units of relays each. The ON/OFF of +8 V and −6 V is done simultaneously.

K104 is controlled by the Power Output ON/OFF Drive (Q102).

K104 is ON when Q102 is ON and the power is output. K104 is OFF when Q102 is OFF and no power is output.

POWER OUTPUT DETECTION SWITCHES [K101 (1/2 AND 2/2)], POWER OUTPUT DETECTION DRIVE (Q103), AND DIGITAL DELAY (U102, D110, R124, AND C124).

For power output adjustment, +18 V is input into K101 (1/2) while −18 V is input into K101 (2/2). Output is then made to each corresponding voltage divider.

Both K101 (1/2) and K101 (2/2) constitute two transfer relays each. K101 is controlled by Q103. When Q103 is ON, K101 becomes connected to the output side of K102 and the signal becomes input into the voltage divider. When Q103 is OFF, K101 becomes connected to the power detection side of K102 and the signal becomes input into the voltage divider.

Q103 is controlled by signals from the Digital Delay (U102, D110, R124, and C124). Signals which turn Q101 ON/OFF are buffered and sent as signals for turning Q103 ON/OFF. In case of ON, signals sent to Q103 are delayed, versus those sent to Q101.

POWER OUTPUT DETECTION SWITCHES [K103 (1/2 AND 2/2)], POWER OUTPUT DETECTION DRIVE (Q104), AND DIGITAL DELAY (U102, D111, R126, AND C123).

For power output adjustment, +8 V is input into K103 (1/2) while −6 V is input into K103 (2/2). Output is then made to each corresponding voltage divider.

Both K103 (1/2) and K103 (2/2) constitute two transfer relays each. K103 is controlled by Q104. When Q104 is ON, K103 becomes connected to the output side of K104 and the signal becomes input into the voltage divider. When Q104 is OFF, K103 becomes connected to the power detection side of K104 and the signal becomes input into the voltage divider. Q104 is controlled by signals from the Digital Delay (U102, D111, R126, and C123). Signals which turn Q102 ON/OFF are buffered and sent as signals for turning Q104 ON/OFF. In case of ON, signals sent to Q104 are delayed, versus those sent to Q102.

VOLTAGE DIVIDERS (R18 AND R22) & (R17 AND R21)

The electrical potentials output from K101 (1/2) and K101 (2/2) are divided by voltage dividers R18 and R22, and R17 an R21. The divided potentials are then input into Error Current Amplifiers.

VOLTAGE DIVIDERS (R16 AND R20) & (R15 AND R19)

The electrical potentials output from K103 (1/2) and K103 (2/2) are divided by voltage dividers R16 and R20, and R15 and R19. The divided potentials are then input into Error Current Amplifiers.

VOLTAGE DIVIDER (R40)

R40 constitutes a complex resistor of 2k and 10k. The electric potential output from K102 (1/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U5 b, U21, R23, C22, and C40] is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U9b).

VOLTAGE DIVIDER (R41)

R41 constitutes a complex resistor of 2k and 10k. The electric potential output from K102 (2/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U6 b, U22, R25, C24, and C41] is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U9a).

CIRCUIT DESCRIPTION

VOLTAGE DIVIDER (R42)

R42 constitutes a complex resistor of 2k and 10k. The electric potential output from K103(1/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U7 b, R27, and C26] is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U10b).

VOLTAGE DIVIDER (R43)

R43 constitutes a complex resistor of 2k and 10k. The electric potential output from K103(2/2) is sent to the 10k resistance side while that output from the Reference Voltage Generator [U8 b, R29, and C28] is sent to the 2k resistance side. The COM potentials of the 2k and 10k resistor become input into the Error Current Amplifier (U10a).

ERROR CURRENT AMPLIFIER (U5a)

The electric potentials output from the Voltage Dividers (VR3 and R63) and those output from the Reference Voltage Generator A (R24 and C23) are compared and their errors amplified. They are then input into Signal Selectors (D19 and D20).

ERROR CURRENT AMPLIFIER (U6a)

The electric potentials output from the Voltage Dividers (VR4 and R64) and those output from the Reference Voltage Generator A (R26 and C25) are compared and their errors amplified. They are then input into Signal Selectors (D21 and D22).

ERROR CURRENT AMPLIFIER (U7a)

The electric potentials output from the Voltage Dividers (VR5 and R65) and those output from the Reference Voltage Generator A (R28 and C27) are compared and their errors amplified. They are then input into Signal Selectors (D23 and D24).

ERROR CURRENT AMPLIFIER (U8a)

The electric potentials output from the Voltage Dividers (VR6 and R66) and those output from the Reference Voltage Generator A (R30 and C29) are compared and their errors amplified. They are then input into Signal Selectors (D25 and D26).

ERROR VOLTAGE AMPLIFIER (U9b)

The electric potentials output from the Voltage Divider (R40) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D19 and D20).

ERROR VOLTAGE AMPLIFIER (U9a)

The electric potentials output from the Voltage Divider (R41) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D21 and D22).

ERROR VOLTAGE AMPLIFIER (U10b)

The electric potentials output from the Voltage Divider (R42) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D23 and D24).

ERROR VOLTAGE AMPLIFIER (U10a)

The electric potentials output from the Voltage Divider (R43) and COM electrical potentials are compared and their errors amplified. They are then input into Signal Selectors (D25 and D26).

SIGNAL SELECTORS (D19 AND D20) AND SIGNAL AMPLIFIERS (Q1 AND R52)

D19 and D20 constitute cathode commons and signals, either output from U5a or U9b, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q1 and R52). These signals are amplified by Q1 and R52.

SIGNAL SELECTORS (D21 AND D22) AND SIGNAL AMPLIFIERS (Q2 AND R53)

D21 and D22 constitute cathode commons and signals, either output from U6a or U9a, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q2 and R52). These signals are amplified by Q2 and R53.

SIGNAL SELECTORS (D23 AND D24) AND SIGNAL AMPLIFIERS (Q3 AND R54)

D23 and D24 constitute cathode commons and signals, either output from U7a or U10b, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q3 and R54). These signals are amplified by Q3 and R54.

SIGNAL SELECTORS (D25 AND D26) AND SIGNAL AMPLIFIERS (Q4 AND R55)

D25 and D26 constitute cathode commons and signals, either output from U8a or U10a, are selected depending on their potential condition and in turn input into Signal Amplifiers (Q4 and R55). These signals are amplified by Q4 and R55.

CIRCUIT DESCRIPTION

COMPARISON VOLTAGE GENERATORS (R56 - R58)

The reference voltage is generated from +/− 12 V for establishing whether the main power source output is CV or CC. Potentials for +18 V and +8 V power output are negative and are input into Comparators (U11a and U12a) those for −18 V and −6 V power output are positive and are input into comparators (U11b and U12b).

COMPARATORS (U11a, U11b, U12a AND U12b)

A comparison is made between the signals from the Error Current Amplifiers and the Comparison Voltage Generator to establish whether the conditions of each main power source output are CV or CC. The condition of the power output is determined and the corresponding signal is input into the CPU.

REFERENCE VOLTAGE GENERATOR V (U5b, U21, R23, C22 AND C40)

The reference voltage for the + 18 V power output is generated by U21, R23, C22 and C40, and led through the buffer constituting U5b. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR V (U6b, U22, R25, C24 AND C41)

The reference voltage for the − 18 V power output is generated by U22, R25, C24 and C41, and led through the buffer constituting U6b. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR V (U7b, R27, AND C26)

The reference voltage for the + 8 V power output is generated by R27 and C26, and led through the buffer constituting U7b. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR V (U8b, R29, AND C28)

The reference voltage for the − 6 V power output is generated by R29 and C28, and led through the buffer constituting U8b. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R 24 AND C23)

The reference voltage for the +18 V power output is generated by R24 and C23. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R26 AND C25)

The reference voltage for the −18 V power output is generated by R26 and C25. This voltage is normally a positive potential.

REFERENCE VOLTAGE GENERATOR A (R28 AND C27)

The reference voltage for the +8 V power output is generated by R28 and C27. This voltage is normally a negative potential.

REFERENCE VOLTAGE GENERATOR A (R30 AND C29)

The reference voltage for the −6 V power output is generated by R30 and C29. This voltage is normally a positive potential.

+/− 18 V TIMING GENERATOR (U25)

Each U21 and U22 functions in a conducting condition in case the +/− 18 V Reference Voltage Generator V becomes reset. With the exception of the above case, signals are sent for keeping a non- conducting condition.

COMPARATORS (U26b, R133 AND R137) AND REFERENCE VOLTAGE GENERATORS (R129 AND R131)

The comparators compare electrical potentials, from Voltage Dividers (R18 and R22), and voltage (approx. +2 V), from Reference Voltage Generators (R129 and R131). They then send ON/OFF signals to the AC Voltage Switch Drive (Q5). U26b carries hysteresis due to R133 and R137.

COMPARATORS (U26a, R133 AND R138) AND REFERENCE VOLTAGE GENERATORS (R130 AND R132)

The comparators compare electrical potentials, from Voltage Dividers (R17 and R21), and voltage (approx. −2 V), from Reference Voltage Generators (R130 and R132). They then send ON/OFF signals to the AC Voltage Switch Drive (Q6). U26a carries hysteresis due to R134 and R138.

NEGATIVE VOLTAGE DETECTION SWITCH [U20 (x)]

One potential, out of four negative potentials detected from voltage dividers of each voltage and current detection sections, becomes selected and sent to the next Voltage Detection switch [U18 (y)]. This switch is controlled by 3 digital signals (D22, D23, and D24)and a non-conductive condition takes effect when selection is being carried out.

POSITIVE VOLTAGE DETECTION SWITCH [U20 (y)]

One potential, out of four positive potentials detected from voltage dividers of each voltage and current detection sections, becomes selected and sent to the next Voltage Detection Switch [U18 (y)]. This switch is controlled by 3 digital signals (D22, D23, and D24) and a non-conductive condition takes effect when selection is being carried out.

D22	D23	D24	Conductivity and selected potential at [U20 (x)]	Conductivity and selected potential at [U20 (y)]
H	—	—	Non-conductivity	Non-conductivity
L	L	L	−18 V potential	+18 V potential
L	H	L	−6 V potential	+8 V potential
L	L	H	+18 V electrical current potential	−18 V electrical current potential
L	H	H	+8 V electrical current potential	−6 V electrical current potential

CIRCUIT DESCRIPTION

VOLTAGE DETECTION SWITCH [U18 (y)]

One electric potential, selected out of potentials output from [U20 (x)], [U20 (y)] or COM, is sent to the Comparator. This switch is controlled by 3 digital signals (D13, D14, and D15) and a non-conductive condition takes effect when selection is being carried out.

D13	D14	D15	Conductivity and selected potential
H	—	—	Non-conductivity
L	L	L	U20 (x) potential
L	H	L	U20 (y) potential
L	L	H	COM potential
L	H	H	COM potential

+ / – REFERENCE VOLTAGE GENERATOR DAC (U4, U17, D4, R8 - R13, AND R75 - R82)

All refernce voltages for the power source are generated here. U17 constitutes a 12 bit electric current output type DAC. Current-to-voltage conversion is carried out in U4a and U4b. Positive potentials are generated in U4b while negative ones are generated in U4a. The digital signals used in DAC are D1 - D12. This DAC, however, can be easily used as a 14 bit DAC with an addition of 2 bits, digital signals D16, D21, and R75 - R82, on the LSB side. The reference voltage for AMP U4a and U4b, for + / – electric current to voltage conversion, becomes generated by D4 and R8 - R13.

Input digital signal	000H	3FFFH
Generated + Voltage TYP value	– 186 mV	+ 3,910 V
Generated – Voltage TYP value	+ 176 mV	– 3,920 V

REFERENCE VOLTAGE SWITCH [U18 (x)]

Either the +/– reference voltage output from U4a or U4b is selected and input into the next Reference Voltage Switch (U19) or the Comparator (U16). This switch is controlled by 3 digital signals (D13, D14, and D15) and a non-conductive condition takes effect when selection is being carried out.

D13	D14	D15	Conductivity & selected potential
H	—	—	Non-conductivity
L	L	L	Negative reference voltage
L	H	L	Positive reference voltage
L	L	H	Negative reference voltage
L	H	H	Positive reference voltage

REFERENCE VOLTAGE SWITCH (U19)

A signal output from U18 is input into one of the 8 Reference Voltage Generators V and A. This switch is controlled by 4 digital signals (D17, D18, D19, or D20) and a non-conductive condition takes effect when selection is being carried out.

D17	D18	D19	D20	Conductivity and destination of signal
H	—	—	—	Non-conductivity
L	L	L	L	+ 18 V Reference Voltage Generator
L	H	L	L	+ 18 A Reference Voltage Generator
L	L	H	L	– 18 V Reference Voltage Generator
L	H	H	L	– 18 A Reference Voltage Generator
L	L	L	H	+ 8 V Reference Voltage Generator
L	H	L	H	+ 8 A Reference Voltage Generator
L	L	H	H	– 6 V Reference Voltage Generator
L	H	H	H	– 6 A Reference Voltage Generator

COMPARATOR (U16)

A comparison is made on the potentials of signals sent from [U18 (x) and (y)] and determined data is sent to the CPU via the Signal Converter. Overall speaking, data is output following successive comparison.

Determined data	Signals from [U18 (x)]	Signals from [U18 (y)]
Detection of + reference voltage OV data	+ reference voltage	COM potential
Detection of – reference voltage OV data	– reference voltage	COM potential
Detection of + 18 V potential value	+ reference voltage	Voltage divider (R18, R22)
Detection of + 18 A potential value	– reference voltage	Voltage divider (VR3, R63)
Detection of – 18 V potential value	+ reference voltage	Voltage divider (R17, R21)
Detection of – 18 A potential value	– reference voltage	Voltage divider (VR4, R64)
Detection of + 8 V potential value	+ reference voltage	Voltage divider (R16, R20)
Detection of + 8 A potential value	– reference voltage	Voltage divider (VR5, R65)
Detection of – 6 V potential value	+ reference voltage	Voltage divider (R15, R19)
Detection of – 6 V potential value	– reference voltage	Voltage divider (VR6, R66)

CIRCUIT DESCRIPTION

In order to minimize offset error in U16a, U16b is used as a buffer and offset error becomes canceled throughout U16.

SIGNAL CONVERTER (D5 AND R14)

The +/− 12 V signals sent from U16 and -12 V signals sent from D5 and R14 become converted and sent to the CPU.

DATA LATCH (U13, U14, AND U15)

The 24 bit data sent to the serial from the CPU are serial parallel converted and output as 24 bit parallel data.

ISOLATOR AND +5 V GENERATOR

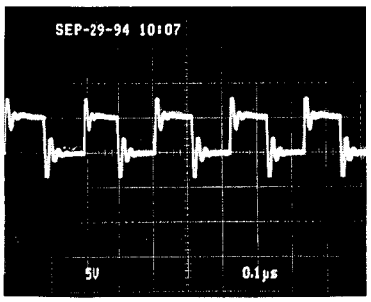
The CPU and AMP are electrically isolated and signals between them are transmitted using photo couplers in U103, U105 and U106.

The power source for the CPU side is +5 V generated in D101, C101, and U101.

NOISE SUPPRESSOR

In an effort to prevent noise, the CPU and Panel are equipped inside a shielded case. There is some noise, however, that passes through the line of transmission between the CPU and Isolator. Such line noise is removed by the application of through type condensers on 12 lines, including the power source line.

CPU



U4 - 64 Waveform, CPU Clock Waveform

By attaching X'tal oscillator X1, C3 and C4 to pins 2 and 3 of U4, U4 can be operated at half the frequency.

KEYBOARD INPUT, ROTARY ENCODER INPUT, INPUT PORT, AND INTERRUPT

When any of the keys (S51 - S63) are , pressed, the output of U55 becomes "L" and the CPU is interrupted. The pressed key becomes decided by signals (2 lines) from Output Port U53 and from Input Port U54. When the rotary encoder is operated, the collector potential of either Q62 or Q63 becomes "L", i.e. passing through the sequence U57e → U57f → U56, and this potential interrupts the CPU. The Rotary Encoder counts within a given time pass through U57a and U57b, and is input into the CPU via Input Port U7. As for the up/down decision of the encoder, data sent to the CPU via Input Port U7 is decided. This is because the Q output of U56a and U56b falls to "L", when data from the encoder first interrupts the CPU, and this state is maintained. Besides data from the keyboard or the rotary encoder, 3 types of data from the AMP and isolator are input into the Input Port U7 and U10. These data are different from those for the previously mentioned interrupt input. They are periodically read out by the CPU within the program loop, reaching the CPU via the Input Port U7 and U10.

Details of the said data are as a following:
(1) Comparative U14 data (Successive comparison data)
(2) Positive output data (CC state at "L")
(3) Negative output data (CC state at "L")

OUTPUT PORT

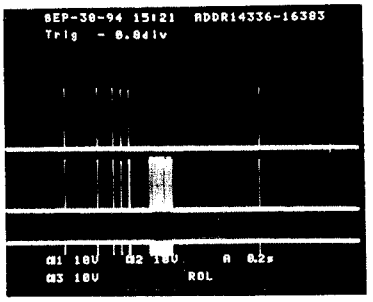
- The 2 pieces of data at Output Port U53 are normally "H". As previously mentioned, pressing any key (S51 - S63) turns either of the above data to "L" while the other remains "Hå00. After data of the opposite nature is output, the key input becomes a decided.
- 5 pieces of data are sent to the AMP digital data generator from Output Port U53 via the Isolator.
- 3 pieces of data are sent to the AMP digital data generator from Output Port U53 via the Isolator.

The above data are as the following :
(1) 24 bit serial data
(2) 24 bit serial data shift clock data
(3) 24 bit serial data latch clock data
They are then sent to the digital data generator via the isolator. This action also compensates for any lag in the response time of the isolator's photo coupler.

DISPLAY DRIVE AND DISPLAY

Both U51 and U52 are ICs for dynamic blinking lights. Transmitters (R83 and C60, R84 and C61, respectively) are equipped. The display is controlled by the previously mentioned 4 pieces of data from U53.

Buffer Unit (X81-2890-00)

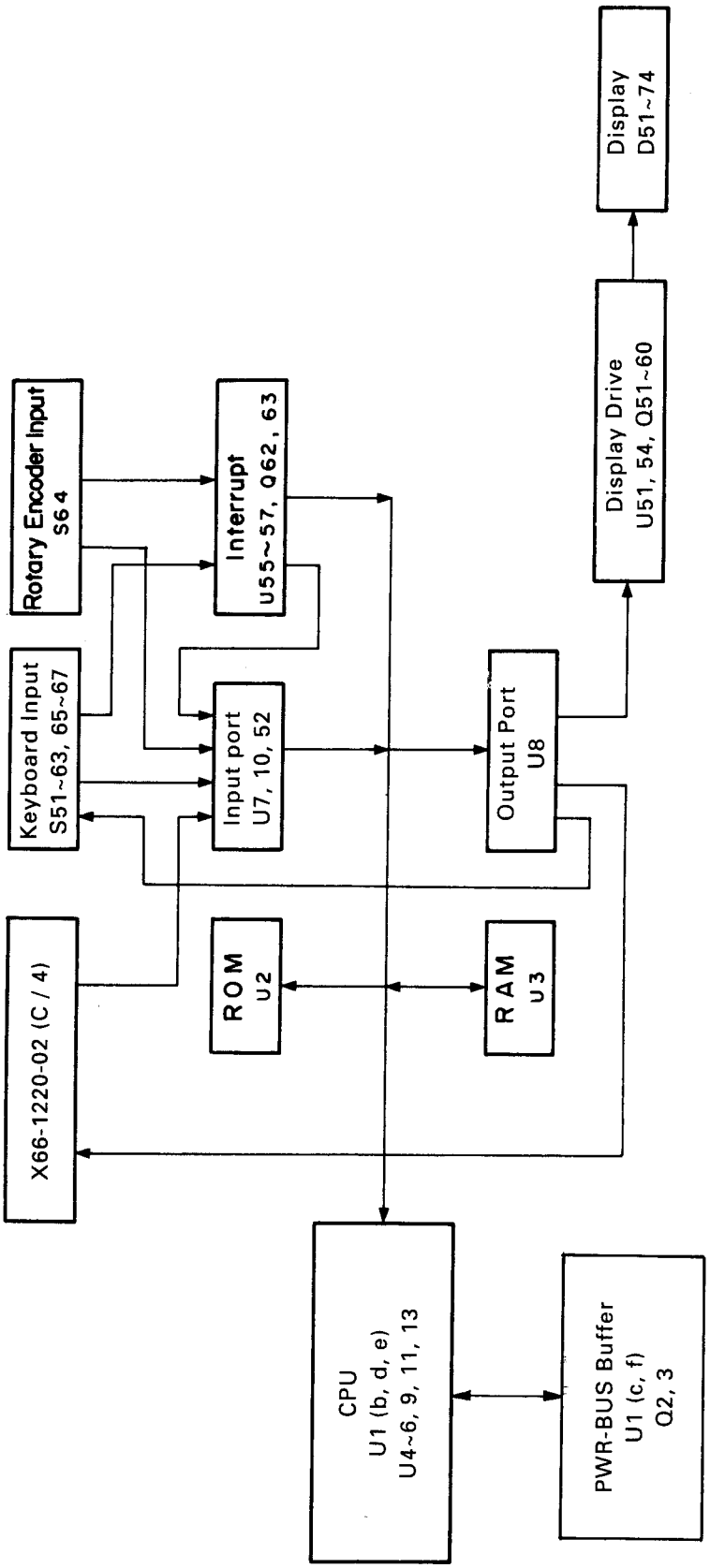


Waveforms at various points when the "ST" command is sent from the PC

This unit converts the RS-232C signal level into the PWR-BUS signal level. The level of the RS-232C signal input through pin 5 of P2-IN is converted by U1 and Q1 into the PWR-BUS signal level, and this signal is sent inside the set through pin 5 of P1.

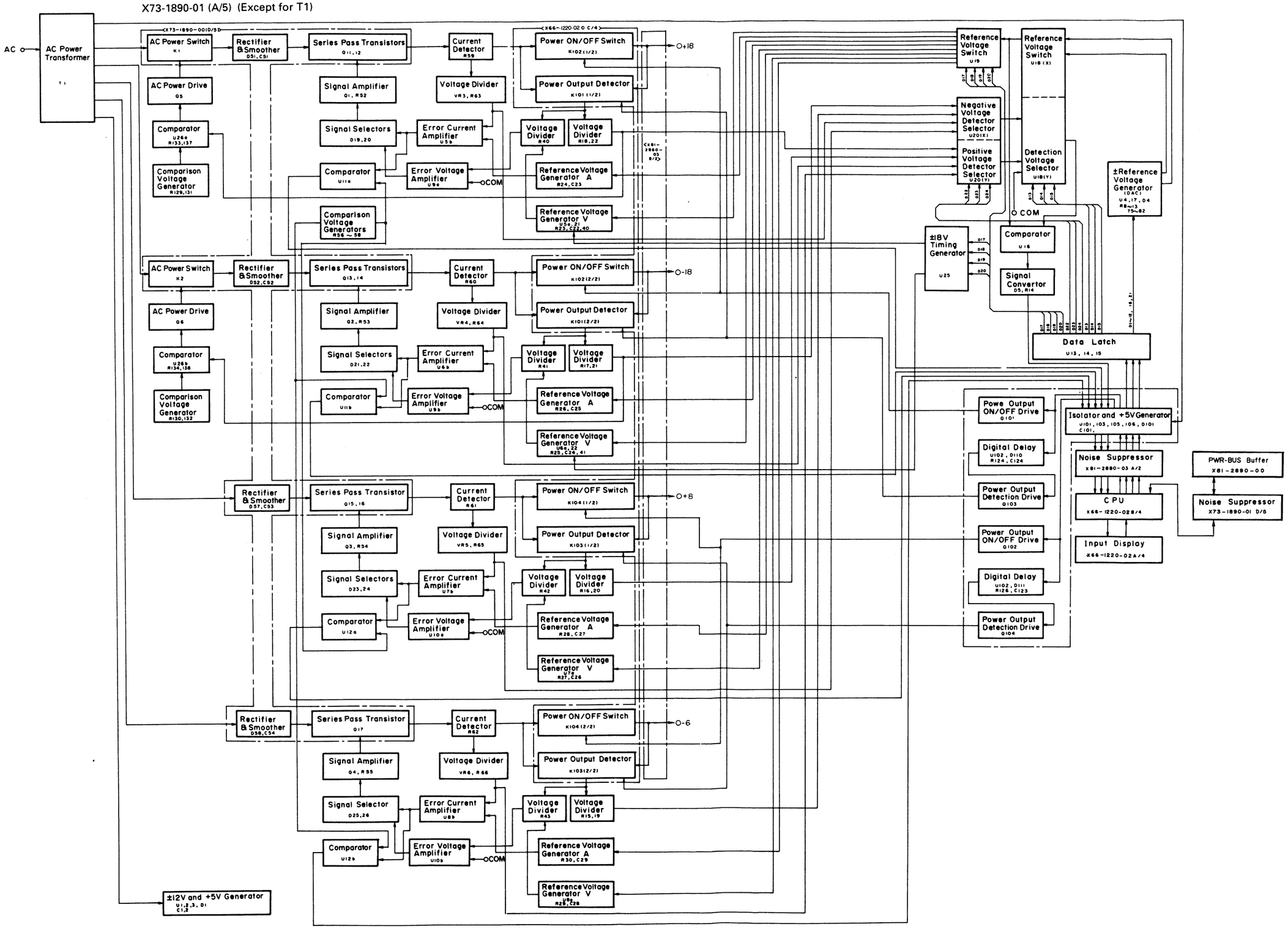
The PWR-BUS signal sent from inside the set is sent to U1 through pin 5 of P1, its level is converted by U1 into the RS-232C signal level, and this signal is output externally through pin 2 of P2-IN. At the same time, the PWR-BUS signal is also output externally through pin 3 of P2-IN and pin 3 of P2-OUT.

BLOCK DIAGRAM



BLOCK DIAGRAM

X73-1890-01 (A/5) (Except for T1)


AC
AC Power Transformer
T1
<X73-1890-0010/5>
AC Power Switch K1
Rectifier & Smoother D51, C51
Series Pass Transistors Q11, 12
Current Detector R59
<X66-1220-02 0 C/4>
Power ON/OFF Switch K102(1/2)
O+18
AC Power Drive Q5
Signal Amplifier Q1, R52
Voltage Divider VR3, R63
Power Output Detector K101(1/2)
Comparator U26a R133, 137
Signal Selectors D19, 20
Error Current Amplifier U5b
Voltage Divider R40
Voltage Divider R18, 22
<X61-2880-03 B/2>
Comparison Voltage Generator R129, 131
Comparator U11a
Error Voltage Amplifier U9a
OCOM
Reference Voltage Generator A R24, C23
Comparison Voltage Generators R56 ~ 58
Reference Voltage Generator V U54, 21 R23, C22, 40
AC Power Switch K2
Rectifier & Smoother D52, C52
Series Pass Transistors Q13, 14
Current Detector R60
Power ON/OFF Switch K102(2/2)
O-18
AC Power Drive Q6
Signal Amplifier Q2, R53
Voltage Divider VR4, R64
Power Output Detector K101(2/2)
Comparator U26b R134, 138
Signal Selectors D21, 22
Error Current Amplifier U6b
Voltage Divider R41
Voltage Divider R17, 21
Comparison Voltage Generator R130, 132
Comparator U11b
Error Voltage Amplifier U9b
OCOM
Reference Voltage Generator A U6a, 22 R26, C25
Reference Voltage Generator V U6a, 22 R25, C24, 41
Rectifier & Smoother D57, C53
Series Pass Transistor Q15, 16
Current Detector R61
Power ON/OFF Switch K104(1/2)
O+8
Signal Amplifier Q3, R54
Voltage Divider VR5, R65
Power Output Detector K103(1/2)
Signal Selectors D23, 24
Error Current Amplifier U7b
Voltage Divider R42
Voltage Divider R16, 20
Comparator U12a
Error Voltage Amplifier U10a
OCOM
Reference Voltage Generator A R28, C27
Reference Voltage Generator V U7a R27, C26
Rectifier & Smoother D58, C54
Series Pass Transistor Q17
Current Detector R62
Power ON/OFF Switch K104(2/2)
O-6
Signal Amplifier Q4, R55
Voltage Divider VR6, R66
Power Output Detector K103(2/2)
Signal Selector D25, 26
Error Current Amplifier U8b
Voltage Divider R43
Voltage Divider R15, 19
Comparator U12b
Error Voltage Amplifier U10b
OCOM
Reference Voltage Generator A R30, C29
Reference Voltage Generator V U8a R29, C28
±12V and +5V Generator U1, 2, 3, D1 C1, 2
Reference Voltage Switch U19
Reference Voltage Switch U18 (X)
Negative Voltage Detector Selector U20(X)
Positive Voltage Detector Selector U20(Y)
Detection Voltage Selector U18(Y)
±Reference Voltage Generator (DAC) U4, 17, D4 R8~13 75~82
COM
±18V Timing Generator U25
Comparator U16
Signal Convertor D5, R14
Data Latch U13, 14, 15
Powe Output ON/OFF Drive Q101
Isolator and +5V Generator U101, 103, 105, 106, D101 C101,
Digital Delay U102, D110 R124, C124
Noise Suppressor X81-2880-03 A/2
PWR-BUS Buffer X81-2890-00
Power Output Detection Drive Q103
C P U X66-1220-02B/4
Noise Suppressor X73-1890-01 D/5
Power Output ON/OFF Drive Q102
Input Display X66-1220-02A/4
Digital Delay U102, D111 R125, C123
Power Output Detection Drive Q104

ADJUSTMENT

To obtain the best performance, periodically calibrate the unit. Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated. When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.

The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer. For optimum adjustment, turn the power on and warm up the scope sufficiently (more than 30 minutes) before starting.

Before calibrating the unit, check the power supply voltage.

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustment.

Multimeter	45	FLUKE
Oscilloscope	CS-4025	KENWOOD

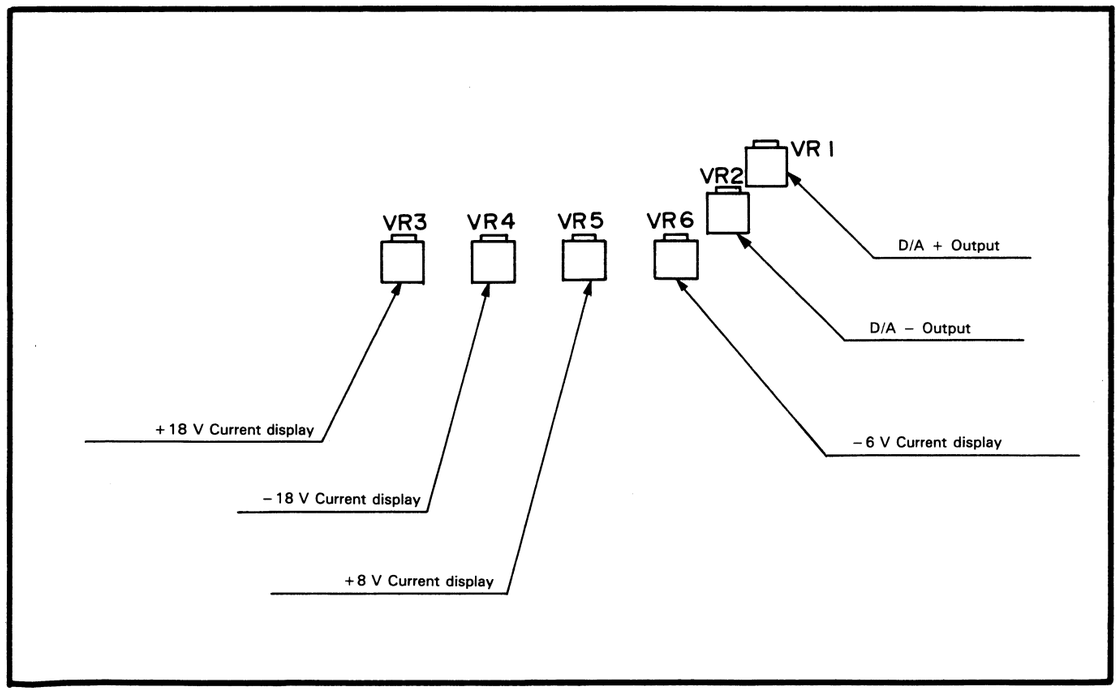
Item	Adjustment VR	Procedure
D/A + Output	VR1	1. Connect the multimeter as follows: Multimeter — PWR + to X73-1890 TP COM to COM terminal on the panel At this point, set the multimeter to the voltage measurement mode. 2. Set the PWR to the voltage adjustment mode. Turn the power switch ON pressing the KEYLOCK switch. Set the KEYLOCK switch free when the LEDs go on. At this point, all the 7-segment LEDs display "8". 3. Press the PRESET1 and observe the multimeter. Assume that the value at this point is P. 4. Press the PRESET2. Then adjust the VR1 so that the multimeter indicates (P + 4.096) V. ±2mV
D/A − Output	VR2	1. Press the PRESET3 and observe the multimeter. Assume that the value at this point is N. 2. Press the VARIABLE. Then adjust the VR2 so that the multimeter indicates (N + 4.096) V. ±2mV. 3. Cancel the voltage adjustment mode by pressing the V switch. (Cancellation will take about 10 seconds.)
+18 V Current Display	VR3	1. Connect the multimeter as follows: Multimeter — PWR + to +18 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates 1.80 A. At this point, make sure that the +18 V LED blinks and the unit maintains a constant current. 3. Adjust the VR3 so that the multimeter indicates 1.80 A.
−18 V Current Display	VR4	1. Connect the multimeter as follows: Multimeter — PWR + to −18 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display −18 V on the 7-segment LED by pressing the −18 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates −1.80 A. At this point, make sure that the −18 V LED blinks and the unit maintains a constant current. 4. Adjust the VR4 so that the multimeter indicates −1.80 A.

ADJUSTMENT

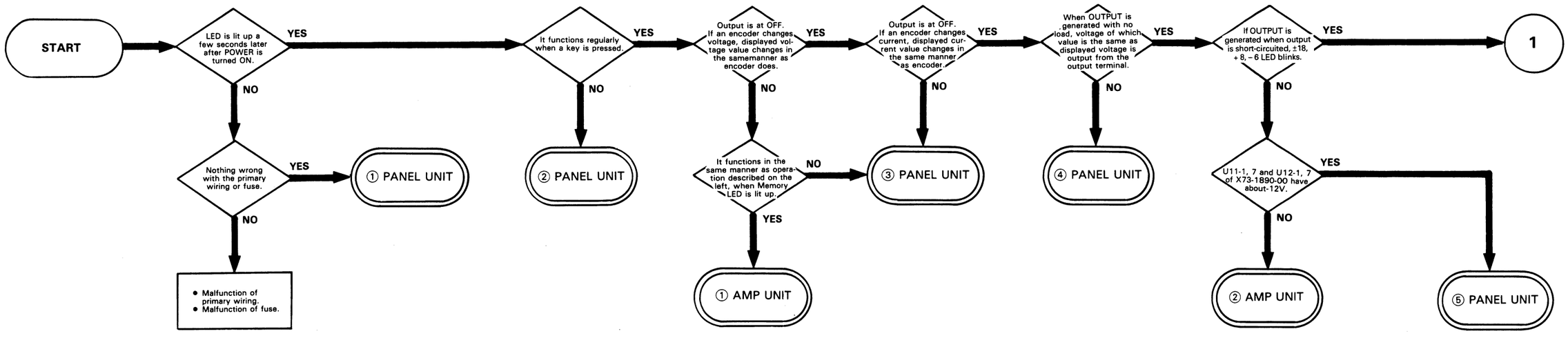
Item	Adjustment VR	Procedure
+8 V Current Display	VR5	1. Connect the multimeter as follows: Multimeter — PWR + to +8 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display +8 V on the 7-segment LED by pressing the +8 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates 2.00 A. At this point, make sure that the +8 V LED blinks and the unit maintains a constant current. 4. Adjust the VR5 so that the multimeter indicates 2.00 A.
−6 V Current Display	VR6	1. Connect the multimeter as follows: Multimeter — PWR + to −6 V terminal on the panel COM to COM terminal on the panel At this point, set the multimeter to the current measurement mode. 2. Display −6 V on the 7-segment LED by pressing the −6 V switch. 3. Turn the OUTPUT switch ON. Then adjust the multimeter by turning the rotary knob so that it indicates −1.00 A. At this point, make sure that the −6 V LED blinks and the unit maintains a constant current. 4. Adjust the VR6 so that the multimeter indicates −1.00 A.

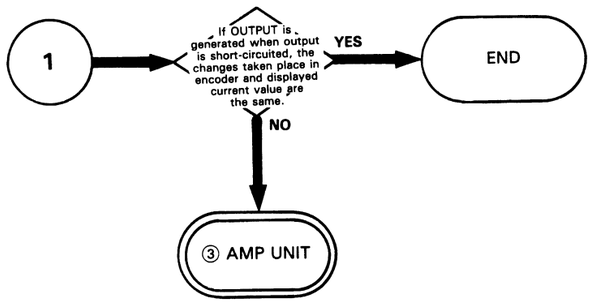
AMP UNIT (X73-1890-01)

Upper



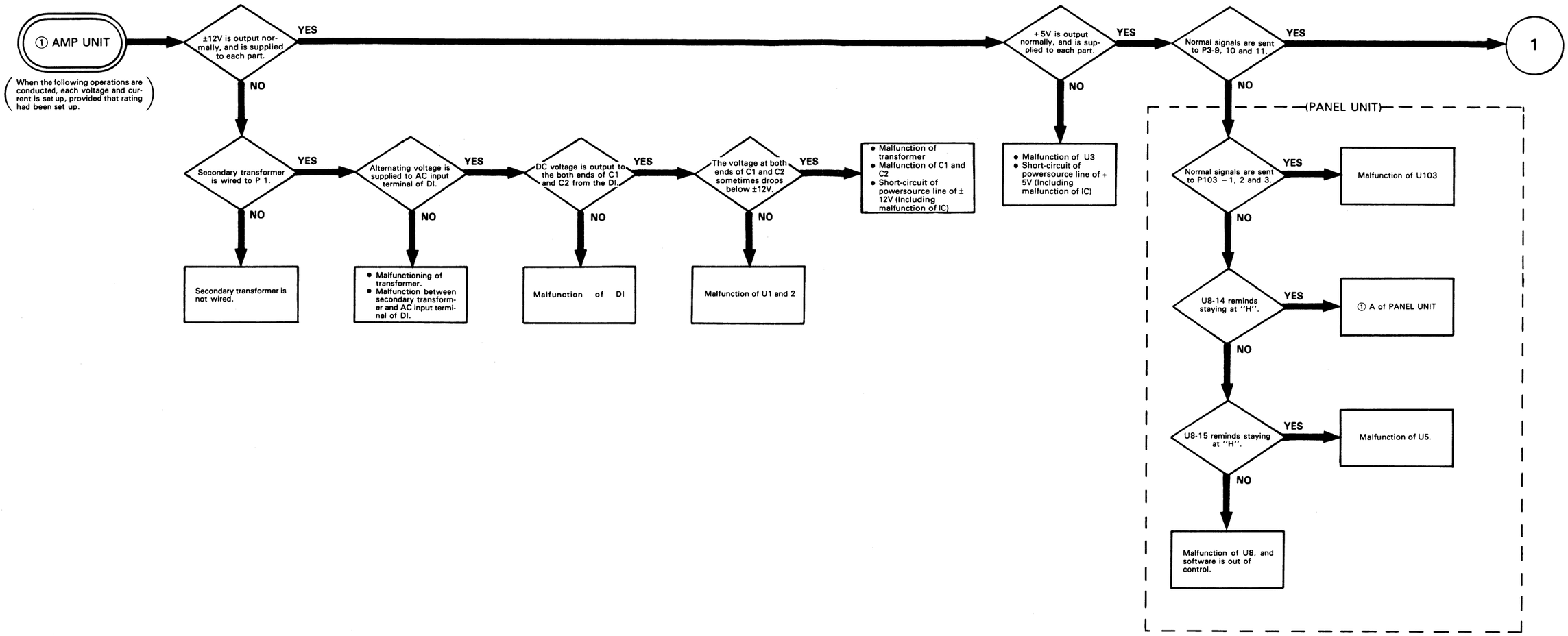
TROUBLESHOOTING


START
LED is lit up a few seconds later after POWER is turned ON.
YES
NO
Nothing wrong with the primary wiring or fuse.
YES
NO
① PANEL UNIT
• Malfunction of primary wiring.
• Malfunction of fuse.
It functions regularly when a key is pressed.
YES
NO
② PANEL UNIT
Output is at OFF. If an encoder changes voltage, displayed voltage value changes in the samemanner as encoder does.
YES
NO
It functions in the same manner as operation described on the left, when Memory LED is lit up.
NO
YES
③ PANEL UNIT
① AMP UNIT
Output is at OFF. If an encoder changes current, displayed current value changes in the same manner as encoder.
YES
NO
When OUTPUT is generated with no load, voltage of which value is the same as displayed voltage is output from the output terminal.
YES
NO
④ PANEL UNIT
If OUTPUT is generated when output is short-circuited, ±18, +8, −6 LED blinks.
YES
NO
U11-1, 7 and U12-1, 7 of X73-1890-00 have about-12V.
YES
NO
② AMP UNIT
⑤ PANEL UNIT
1

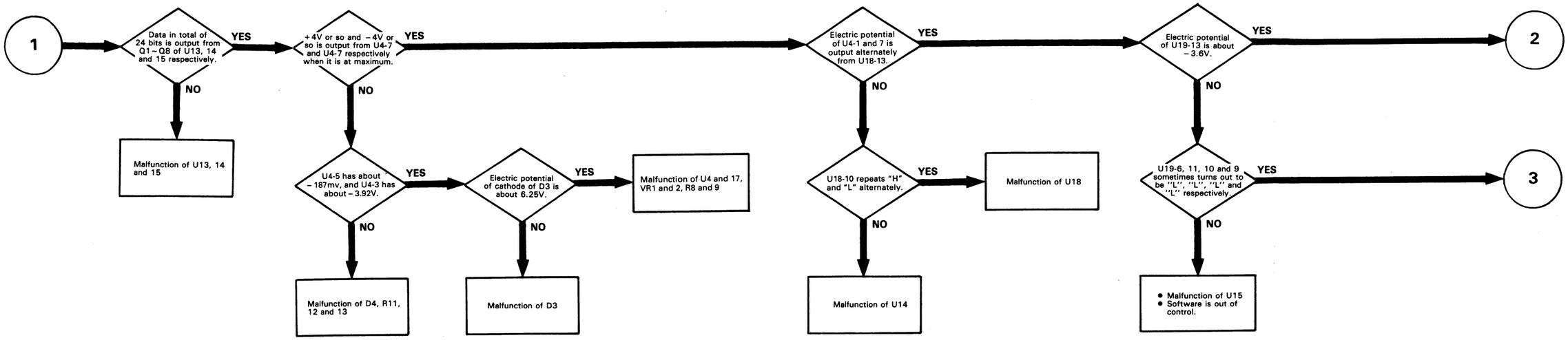

1
If OUTPUT is generated when output is short-circuited, the changes taken place in encoder and displayed current value are the same.
YES
NO
END
③ AMP UNIT

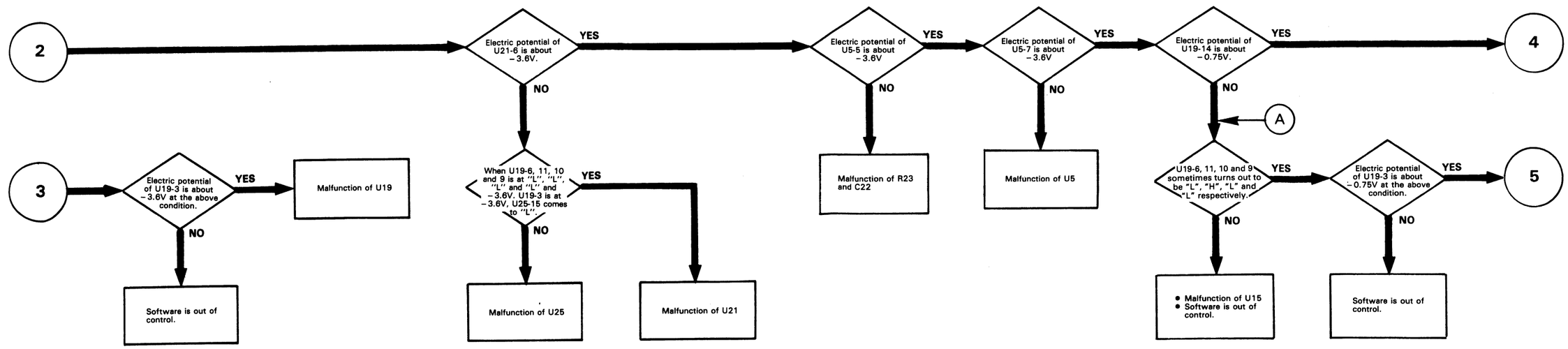
TROUBLESHOOTING

Symptom: When the voltage is varied with the encoder while the OUTPUT is OFF and MEMORY LED is not lit, the indicated voltage does not vary in accordance with the encoder operation.

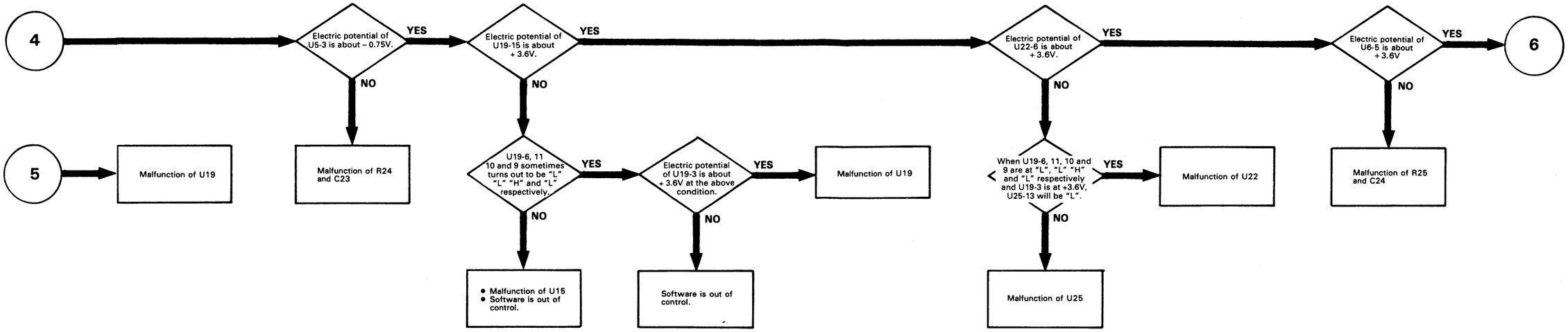

① AMP UNIT
When the following operations are conducted, each voltage and current is set up, provided that rating had been set up.
±12V is output normally, and is supplied to each part.
YES
NO
Secondary transformer is wired to P 1.
YES
NO
Secondary transformer is not wired.
Alternating voltage is supplied to AC input terminal of DI.
YES
NO
• Malfunctioning of transformer.
• Malfunction between secondary transformer and AC input terminal of DI.
DC voltage is output to the both ends of C1 and C2 from the DI.
YES
NO
Malfunction of DI
The voltage at both ends of C1 and C2 sometimes drops below ±12V.
YES
NO
Malfunction of U1 and 2
• Malfunction of transformer
• Malfunction of C1 and C2
• Short-circuit of powersource line of ± 12V (Including malfunction of IC)
+ 5V is output normally, and is supplied to each part.
YES
NO
• Malfunction of U3
• Short-circuit of powersource line of + 5V (Including malfunction of IC)
Normal signals are sent to P3-9, 10 and 11.
YES
NO
1
(PANEL UNIT)
Normal signals are sent to P103 – 1, 2 and 3.
YES
NO
Malfunction of U103
U8-14 reminds staying at "H".
YES
NO
① A of PANEL UNIT
U8-15 reminds staying at "H".
YES
NO
Malfunction of U5.
Malfunction of U8, and software is out of control.

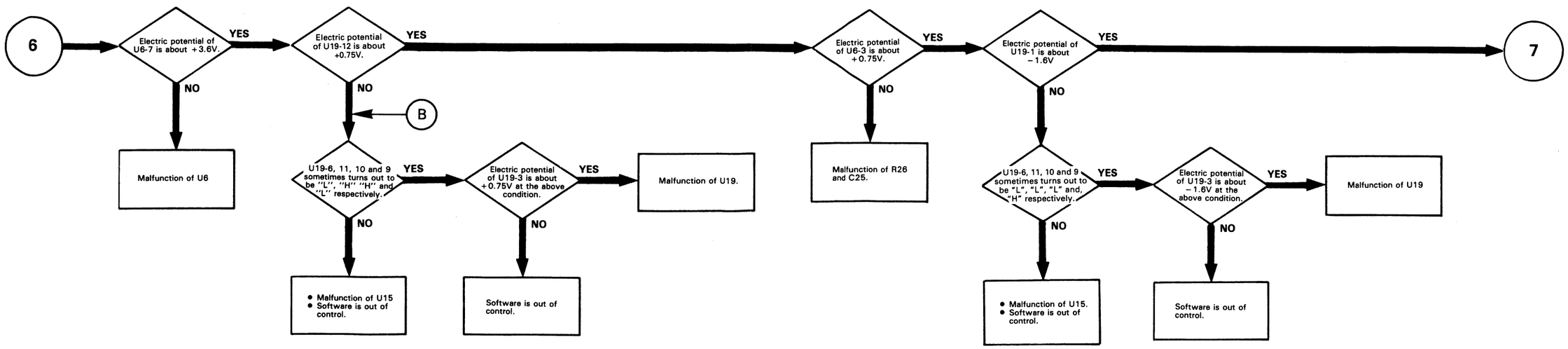
TROUBLESHOOTING

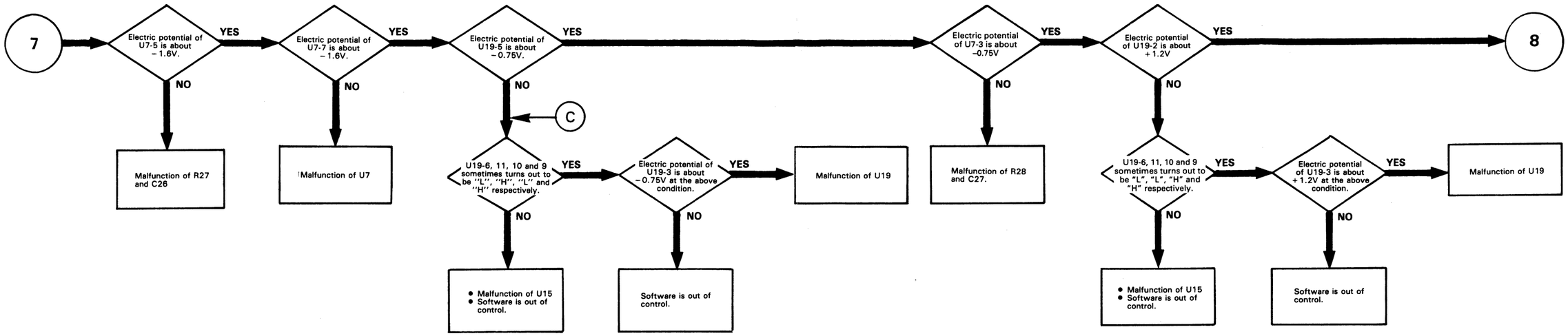

1
Date in total of 24 bits is output from Q1 ~ Q8 of U13, 14 and 15 respectively.
YES
NO
Malfunction of U13, 14 and 15
+4V or so and −4V or so is output from U4-7 and U4-7 respectively when it is at maximum.
YES
NO
U4-5 has about −187mv, and U4-3 has about −3.92V.
YES
NO
Electric potential of cathode of D3 is about 6.25V.
YES
NO
Malfunction of U4 and 17, VR1 and 2, R8 and 9
Malfunction of D4, R11, 12 and 13
Malfunction of D3
Electric potential of U4-1 and 7 is output alternately from U18-13.
YES
NO
U18-10 repeats "H" and "L" alternately.
YES
NO
Malfunction of U18
Malfunction of U14
Electric potential of U19-13 is about −3.6V.
YES
NO
2
U19-6, 11, 10 and 9 sometimes turns out to be "L", "L", "L" and "L" respectively.
YES
NO
3
• Malfunction of U15
• Software is out of control.

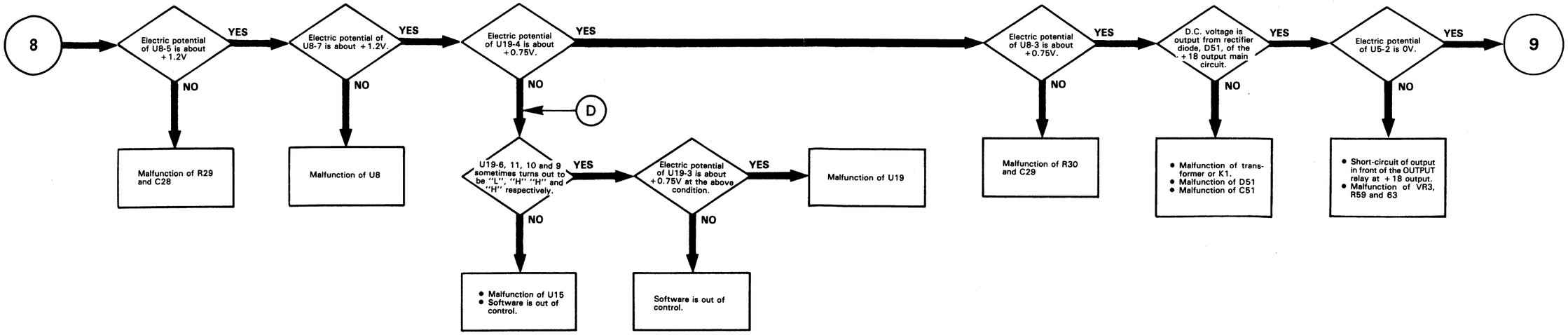


TROUBLESHOOTING

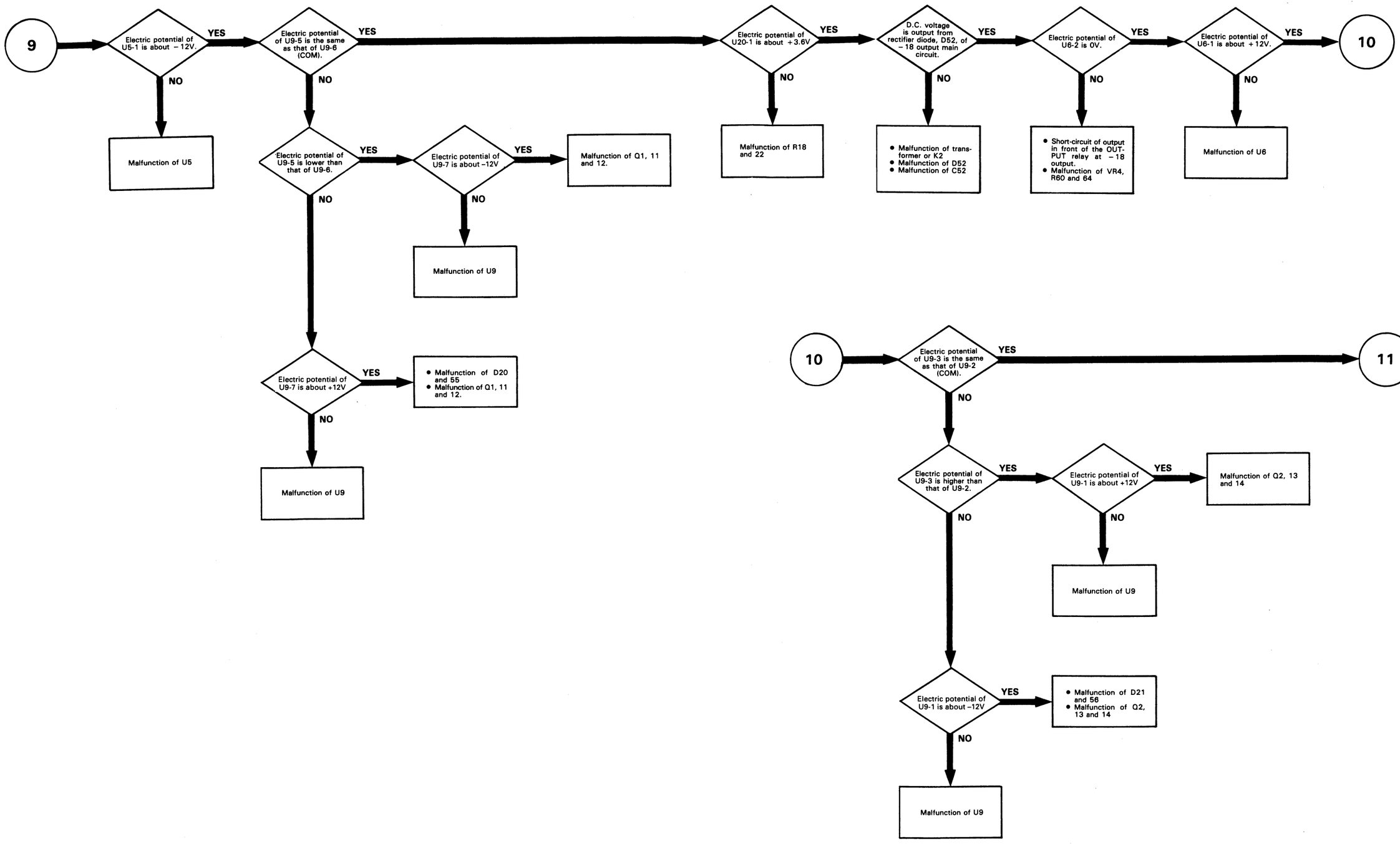

4
Electric potential of U5-3 is about – 0.75V.
YES
NO
Electric potential of U19-15 is about + 3.6V.
YES
NO
Electric potential of U22-6 is about + 3.6V.
YES
NO
Electric potential of U6-5 is about + 3.6V
YES
NO
6
5
Malfunction of U19
Malfunction of R24 and C23
U19-6, 11 10 and 9 sometimes turns out to be "L" "L" "H" and "L" respectively.
YES
NO
Electric potential of U19-3 is about + 3.6V at the above condition.
YES
NO
Malfunction of U19
• Malfunction of U15
• Software is out of control.
Software is out of control.
When U19-6, 11, 10 and 9 are at "L", "L" "H" and "L" respectively and U19-3 is at +3.6V, U25-13 will be "L".
YES
NO
Malfunction of U22
Malfunction of U25
Malfunction of R25 and C24


6
Electric potential of U6-7 is about + 3.6V.
YES
NO
Electric potential of U19-12 is about +0.75V.
YES
NO
B
Electric potential of U6-3 is about + 0.75V.
YES
NO
Electric potential of U19-1 is about – 1.6V
YES
NO
7
Malfunction of U6
U19-6, 11, 10 and 9 sometimes turns out to be "L", "H" "H" and "L" respectively.
YES
NO
Electric potential of U19-3 is about + 0.75V at the above condition.
YES
NO
Malfunction of U19.
• Malfunction of U15
• Software is out of control.
Software is out of control.
Malfunction of R26 and C25.
U19-6, 11, 10 and 9 sometimes turns out to be "L", "L", "L" and, "H" respectively.
YES
NO
Electric potential of U19-3 is about – 1.6V at the above condition.
YES
NO
Malfunction of U19
• Malfunction of U15.
• Software is out of control.
Software is out of control.

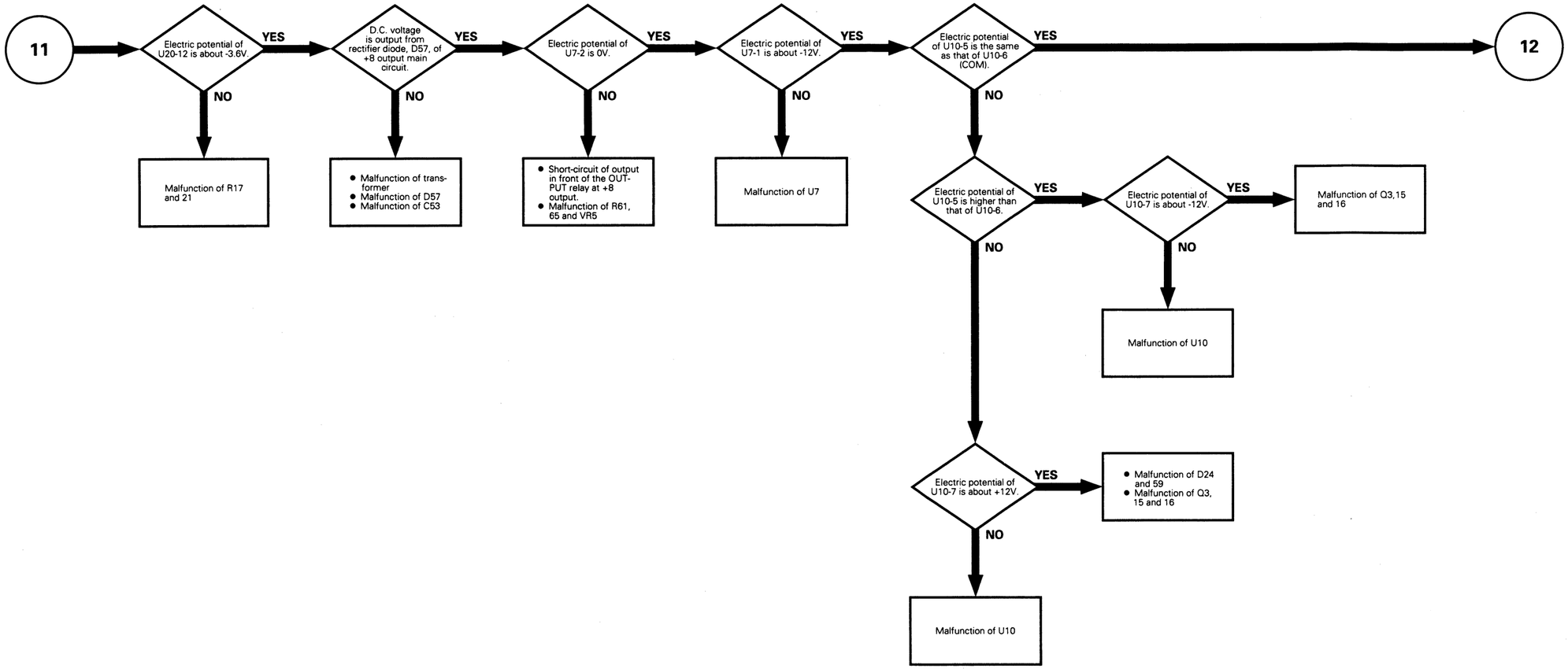

7
Electric potential of U7-5 is about −1.6V.
YES
NO
Malfunction of R27 and C26
Electric potential of U7-7 is about −1.6V.
YES
NO
Malfunction of U7
Electric potential of U19-5 is about −0.75V.
YES
NO
C
U19-6, 11, 10 and 9 sometimes turns out to be "L", "H", "L" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about −0.75V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
Electric potential of U7-3 is about −0.75V
YES
NO
Malfunction of R28 and C27.
Electric potential of U19-2 is about +1.2V
YES
NO
U19-6, 11, 10 and 9 sometimes turns out to be "L", "L", "H" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about +1.2V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
8


8
Electric potential of U8-5 is about +1.2V
YES
NO
Malfunction of R29 and C28
Electric potential of U8-7 is about +1.2V.
YES
NO
Malfunction of U8
Electric potential of U19-4 is about +0.75V.
YES
NO
D
U19-6, 11, 10 and 9 sometimes turns out to be "L", "H" "H" and "H" respectively.
YES
NO
• Malfunction of U15
• Software is out of control.
Electric potential of U19-3 is about +0.75V at the above condition.
YES
NO
Software is out of control.
Malfunction of U19
Electric potential of U8-3 is about +0.75V.
YES
NO
Malfunction of R30 and C29
D.C. voltage is output from rectifier diode, D51, of the +18 output main circuit.
YES
NO
• Malfunction of transformer or K1.
• Malfunction of D51
• Malfunction of C51
Electric potential of U5-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at +18 output.
• Malfunction of VR3, R59 and 63
9

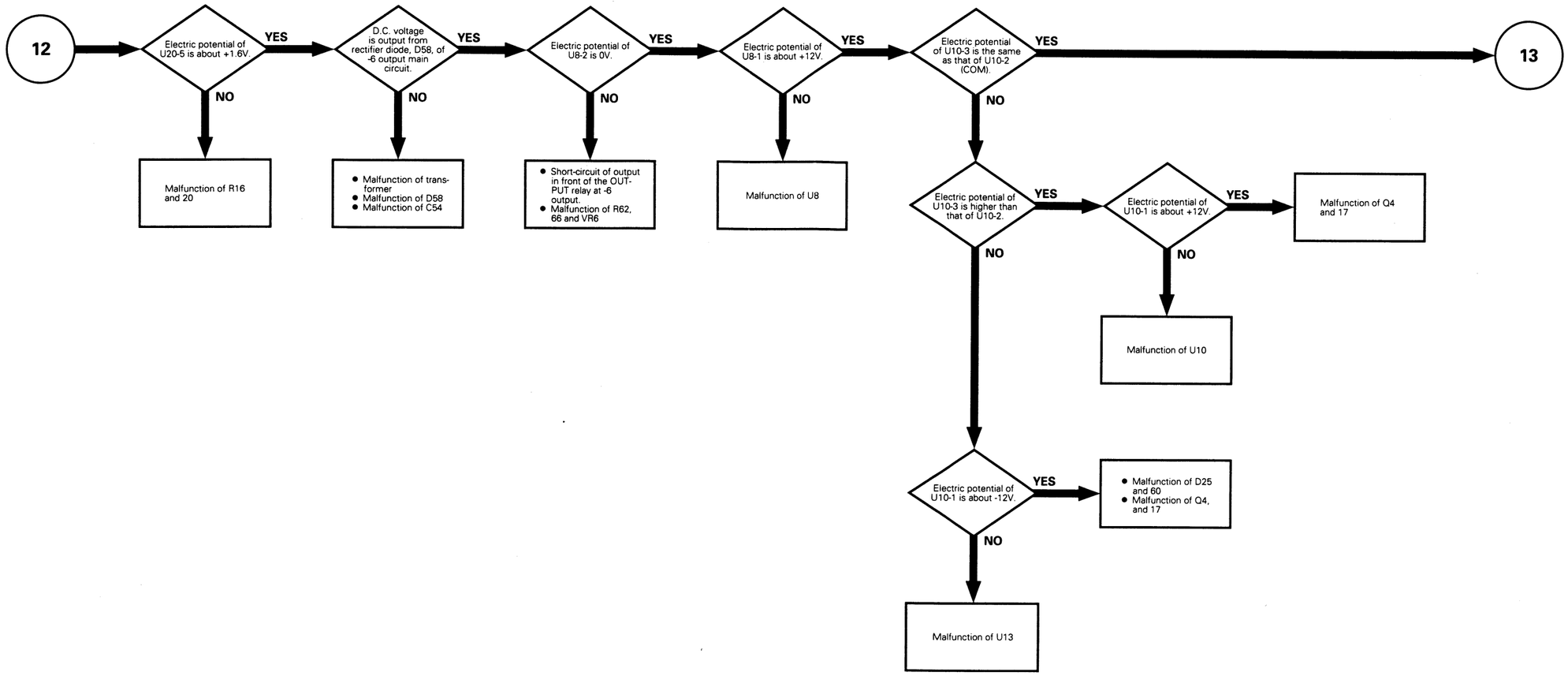
TROUBLESHOOTING


9
Electric potential of U5-1 is about − 12V.
YES
NO
Malfunction of U5
Electric potential of U9-5 is the same as that of U9-6 (COM).
YES
NO
Electric potential of U9-5 is lower than that of U9-6.
YES
NO
Electric potential of U9-7 is about −12V
YES
NO
Malfunction of Q1, 11 and 12.
Malfunction of U9
Electric potential of U9-7 is about +12V
YES
NO
• Malfunction of D20 and 55
• Malfunction of Q1, 11 and 12.
Malfunction of U9
Electric potential of U20-1 is about +3.6V
YES
NO
Malfunction of R18 and 22
D.C. voltage is output from rectifier diode, D52, of − 18 output main circuit.
YES
NO
• Malfunction of transformer or K2
• Malfunction of D52
• Malfunction of C52
Electric potential of U6-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at − 18 output.
• Malfunction of VR4, R60 and 64
Electric potential of U6-1 is about +12V.
YES
NO
Malfunction of U6
10
Electric potential of U9-3 is the same as that of U9-2 (COM).
YES
NO
11
Electric potential of U9-3 is higher than that of U9-2.
YES
NO
Electric potential of U9-1 is about +12V
YES
NO
Malfunction of Q2, 13 and 14
Malfunction of U9
Electric potential of U9-1 is about −12V
YES
NO
• Malfunction of D21 and 56
• Malfunction of Q2, 13 and 14
Malfunction of U9

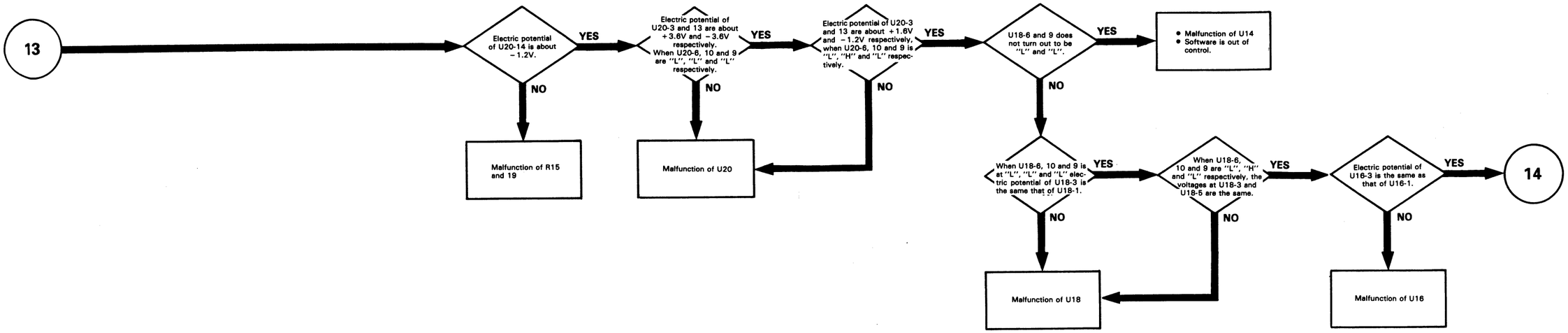
TROUBLESHOOTING

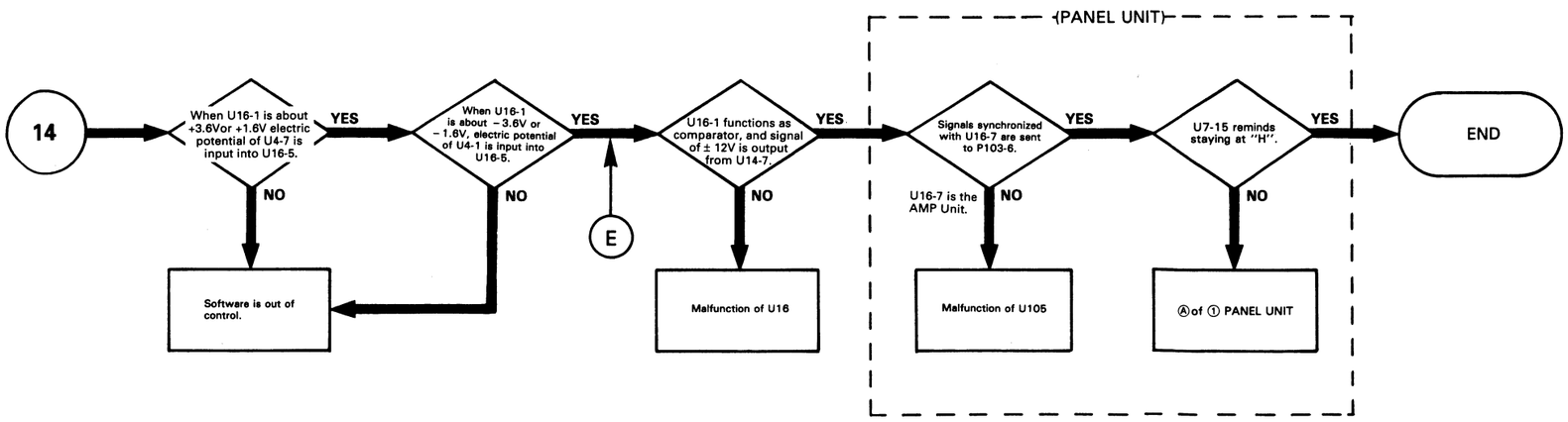

11
Electric potential of U20-12 is about -3.6V.
YES
NO
Malfunction of R17 and 21
D.C. voltage is output from rectifier diode, D57, of +8 output main circuit.
YES
NO
• Malfunction of transformer
• Malfunction of D57
• Malfunction of C53
Electric potential of U7-2 is 0V.
YES
NO
• Short-circuit of output in front of the OUTPUT relay at +8 output.
• Malfunction of R61, 65 and VR5
Electric potential of U7-1 is about -12V.
YES
NO
Malfunction of U7
Electric potential of U10-5 is the same as that of U10-6 (COM).
YES
NO
12
Electric potential of U10-5 is higher than that of U10-6.
YES
NO
Electric potential of U10-7 is about -12V.
YES
NO
Malfunction of Q3,15 and 16
Malfunction of U10
Electric potential of U10-7 is about +12V.
YES
NO
• Malfunction of D24 and 59
• Malfunction of Q3, 15 and 16
Malfunction of U10

TROUBLESHOOTING



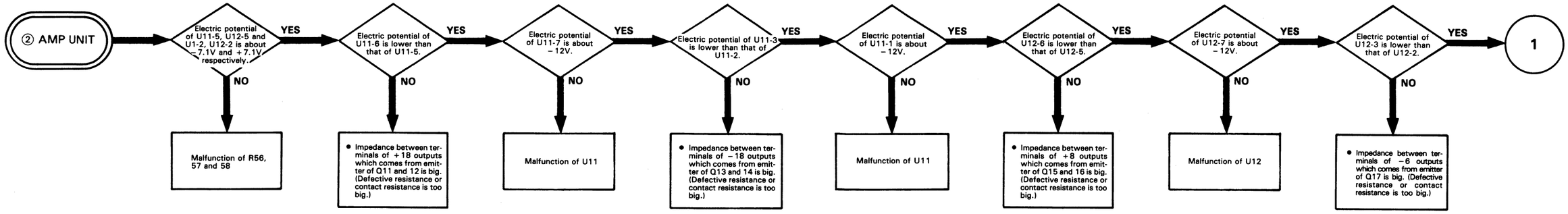
TROUBLESHOOTING

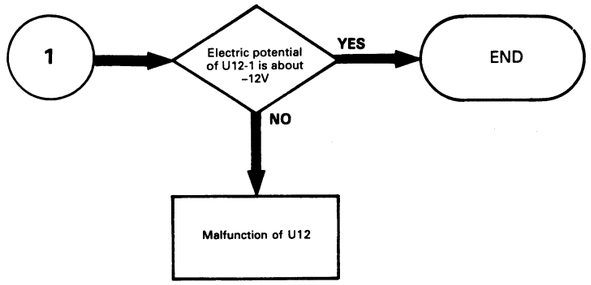

13
Electric potential of U20-14 is about − 1.2V.
YES
NO
Malfunction of R15 and 19
Electric potential of U20-3 and 13 are about + 3.6V and − 3.6V respectively. When U20-6, 10 and 9 are "L", "L" and "L" respectively.
YES
NO
Malfunction of U20
Electric potential of U20-3 and 13 are about + 1.6V and − 1.2V respectively, when U20-6, 10 and 9 is "L", "H" and "L" respectively.
YES
NO
U18-6 and 9 does not turn out to be "L" and "L".
YES
• Malfunction of U14
• Software is out of control.
NO
When U18-6, 10 and 9 is at "L", "L" and "L" electric potential of U18-3 is the same that of U18-1.
YES
NO
Malfunction of U18
When U18-6, 10 and 9 are "L", "H" and "L" respectively, the voltages at U18-3 and U18-5 are the same.
YES
NO
Electric potential of U16-3 is the same as that of U16-1.
YES
NO
Malfunction of U16
14



TROUBLESHOOTING

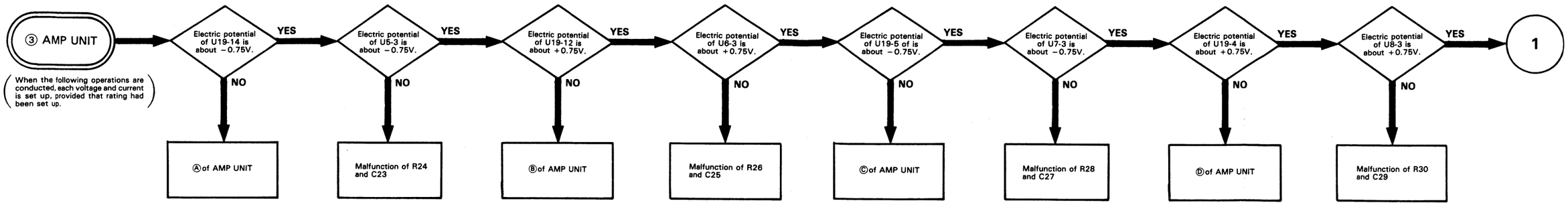
Symptom: When both outputs are used in CC state, the ±18 , +8, –6 LEDs do not blink.

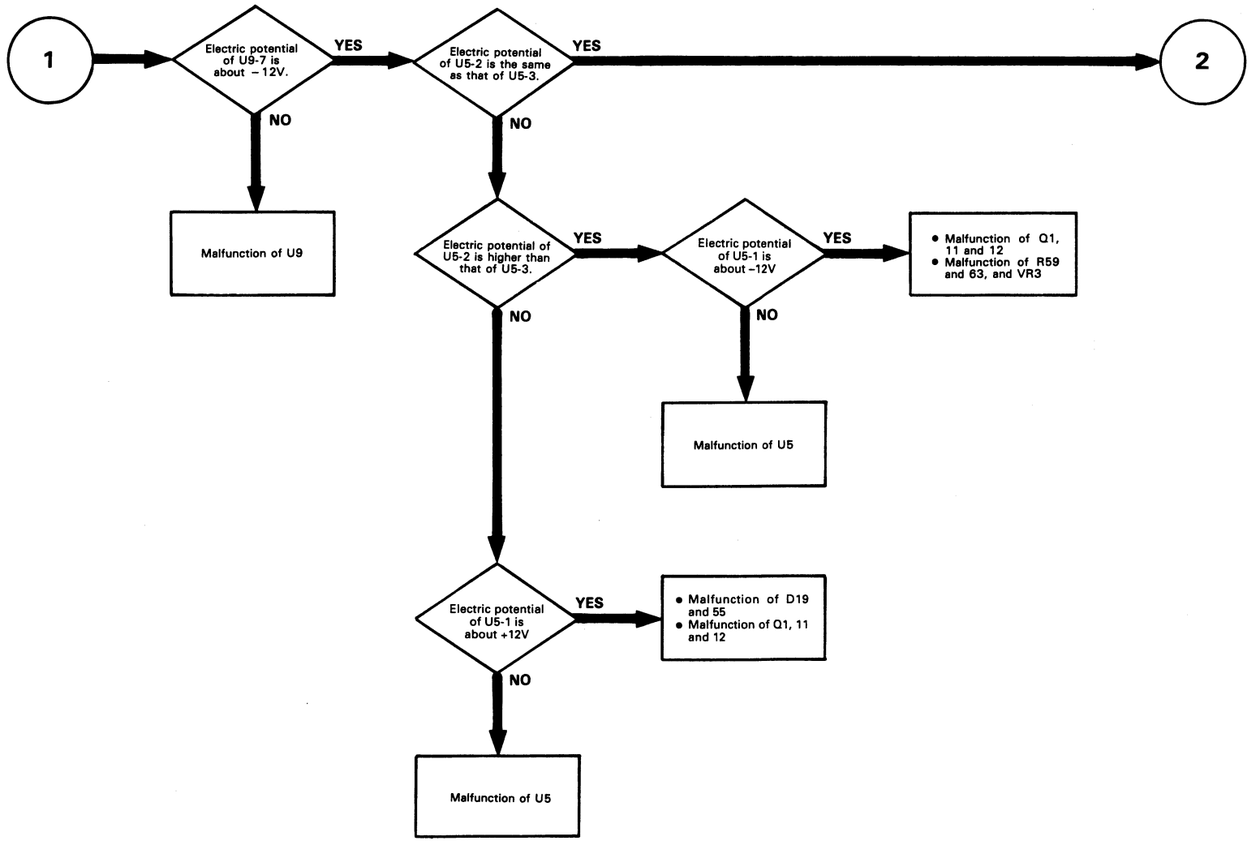

② AMP UNIT
Electric potential of U11-5, U12-5 and U1-2, U12-2 is about –7.1V and +7.1V respectively.
YES
NO
Malfunction of R56, 57 and 58
Electric potential of U11-6 is lower than that of U11-5.
YES
NO
• Impedance between terminals of +18 outputs which comes from emitter of Q11 and 12 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U11-7 is about –12V.
YES
NO
Malfunction of U11
Electric potential of U11-3 is lower than that of U11-2.
YES
NO
• Impedance between terminals of –18 outputs which comes from emitter of Q13 and 14 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U11-1 is about –12V.
YES
NO
Malfunction of U11
Electric potential of U12-6 is lower than that of U12-5.
YES
NO
• Impedance between terminals of +8 outputs which comes from emitter of Q15 and 16 is big. (Defective resistance or contact resistance is too big.)
Electric potential of U12-7 is about –12V.
YES
NO
Malfunction of U12
Electric potential of U12-3 is lower than that of U12-2.
YES
NO
• Impedance between terminals of –6 outputs which comes from emitter of Q17 is big. (Defective resistance or contact resistance is too big.)
1



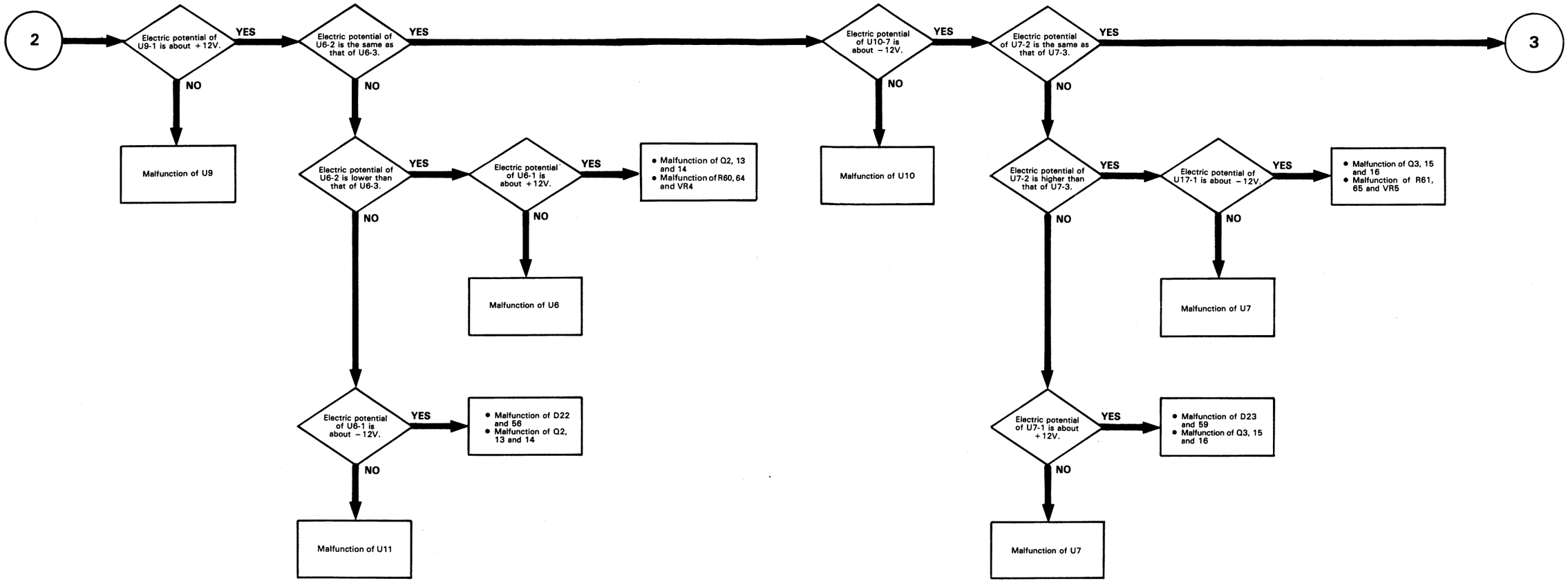
TROUBLESHOOTING

Symptom: When the OUTPUT is switched ON by shorting the output, the indicated current does not vary in accordance with the encoder operation.

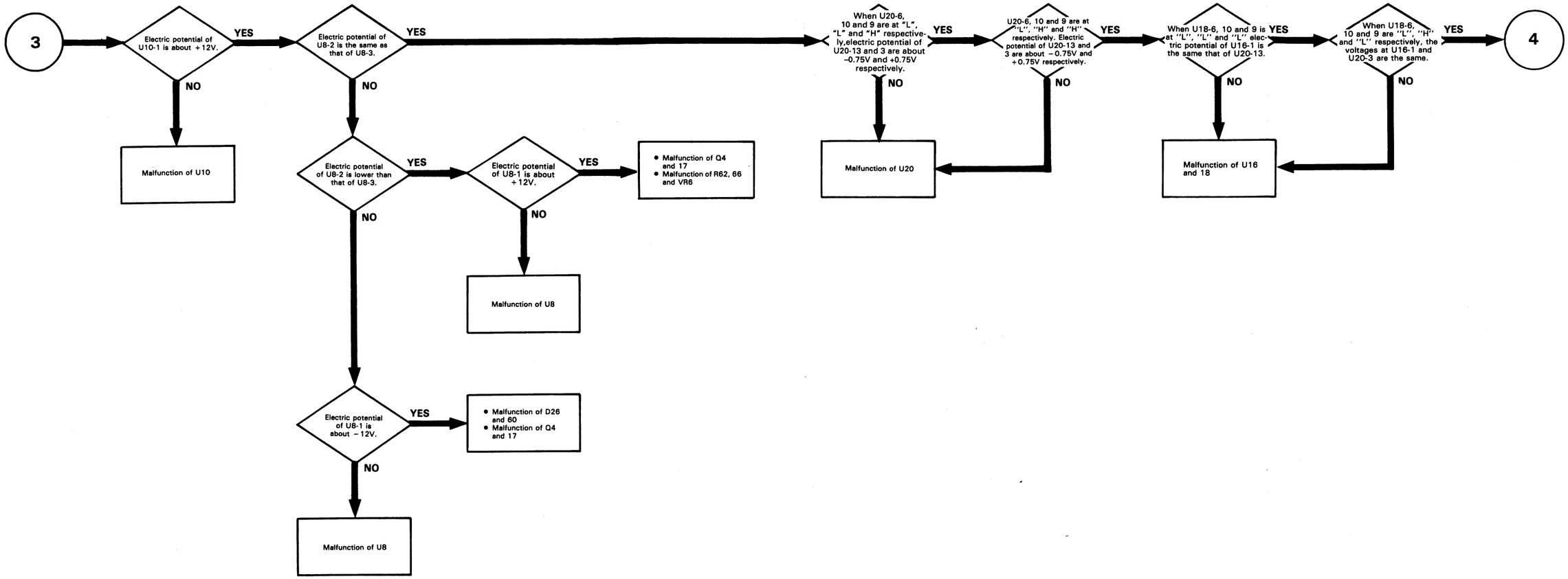




TROUBLESHOOTING

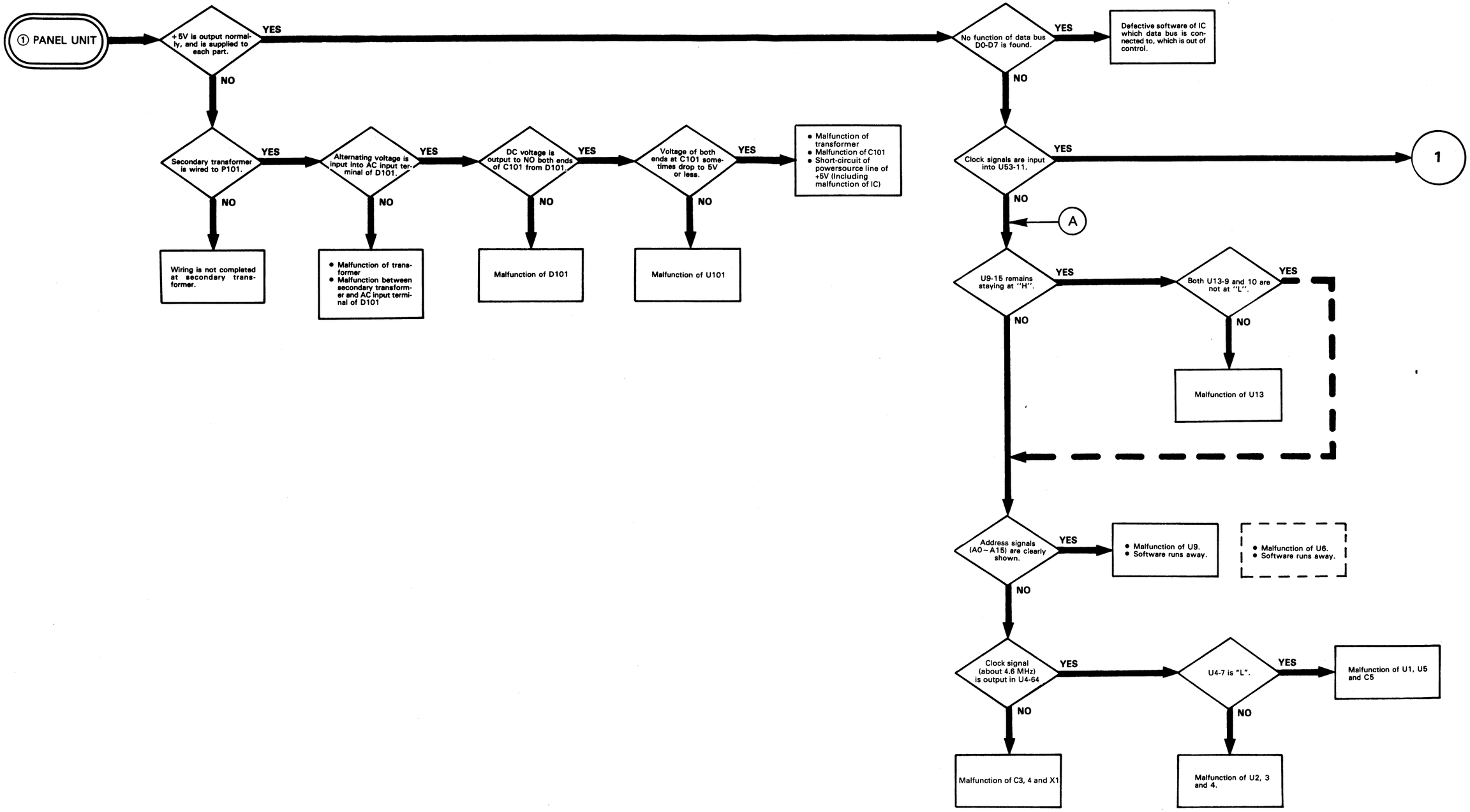


TROUBLESHOOTING

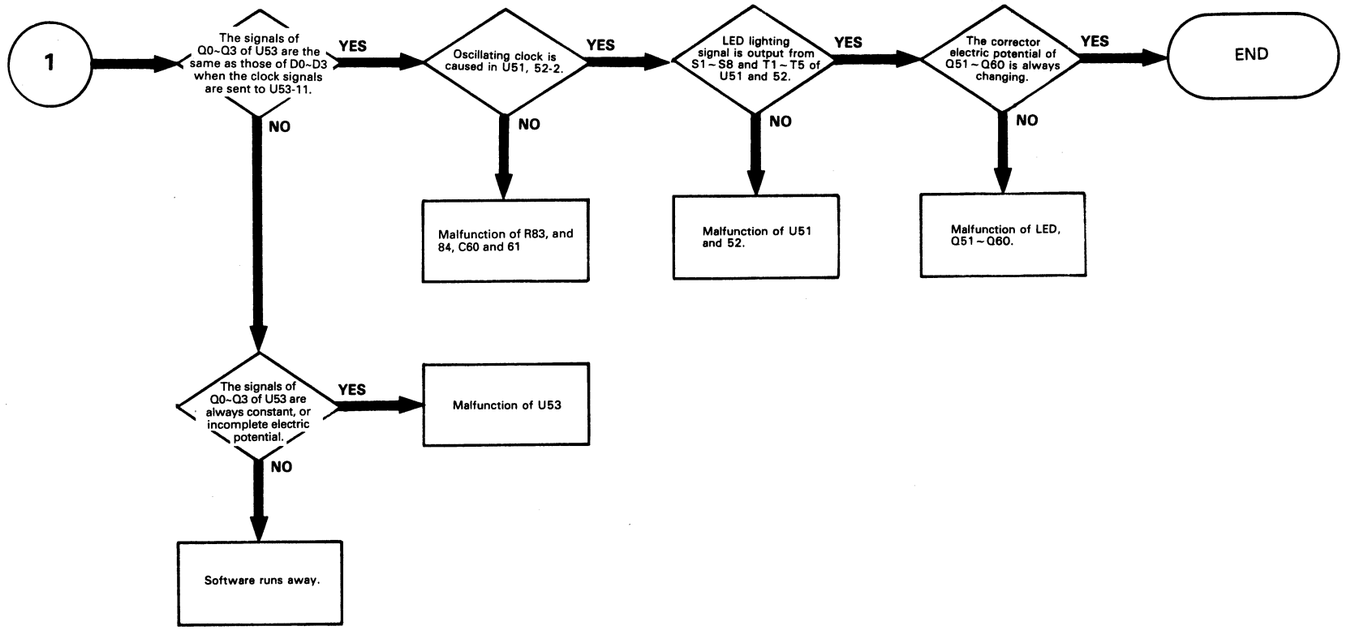

3
Electric potential of U10-1 is about +12V.
YES
NO
Malfunction of U10
Electric potential of U8-2 is the same as that of U8-3.
YES
NO
Electric potential of U8-2 is lower than that of U8-3.
YES
NO
Electric potential of U8-1 is about +12V.
YES
NO
• Malfunction of Q4 and 17
• Malfunction of R62, 66 and VR6
Malfunction of U8
Electric potential of U8-1 is about −12V.
YES
NO
• Malfunction of D26 and 60
• Malfunction of Q4 and 17
Malfunction of U8
When U20-6, 10 and 9 are at "L", "L" and "H" respectively, electric potential of U20-13 and 3 are about −0.75V and +0.75V respectively.
YES
NO
Malfunction of U20
U20-6, 10 and 9 are at "L", "H" and "H" respectively. Electric potential of U20-13 and 3 are about −0.75V and +0.75V respectively.
YES
NO
Malfunction of U20
When U18-6, 10 and 9 is at "L", "L" and "L" electric potential of U16-1 is the same that of U20-13.
YES
NO
Malfunction of U16 and 18
When U18-6, 10 and 9 are "L", "H" and "L" respectively, the voltages at U16-1 and U20-3 are the same.
YES
NO
Malfunction of U16 and 18
YES
4
4
When U16-1 is about −0.75V, electric potential of U4-1 is input into U16-5.
YES
NO
Software is out of control.
When U16-1 is about +0.75V, electric potential of U4-1 is input into U16-5.
YES
NO
Software is out of control.
Ⓔof AMP UNIT

TROUBLESHOOTING

Symptom: The LEDs do not light.

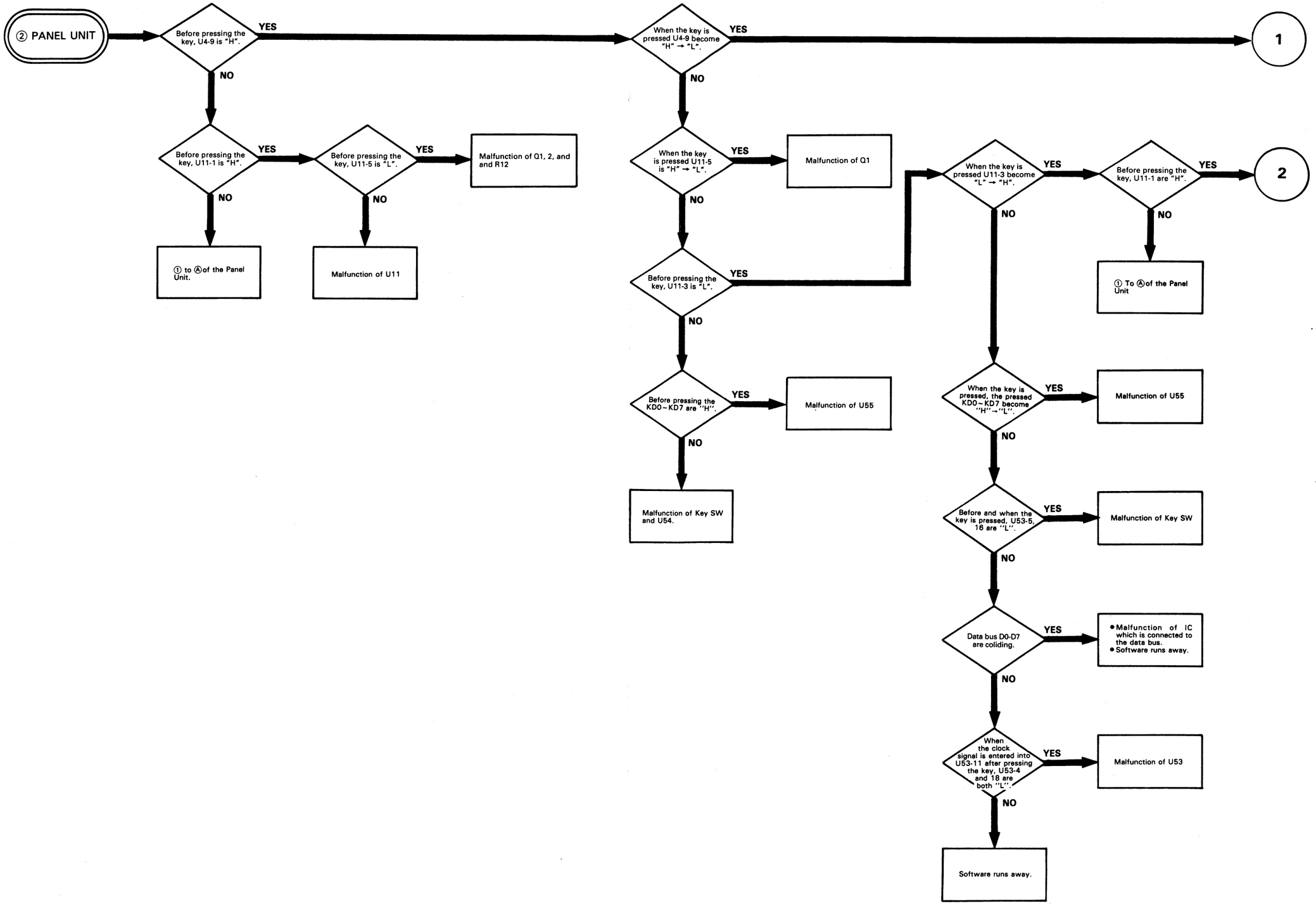

① PANEL UNIT
+5V is output normally, and is supplied to each part.
YES
NO
Secondary transformer is wired to P101.
YES
NO
Wiring is not completed at secondary transformer.
Alternating voltage is input into AC input terminal of D101.
YES
NO
• Malfunction of transformer
• Malfunction between secondary transformer and AC input terminal of D101
DC voltage is output to NO both ends of C101 from D101.
YES
NO
Malfunction of D101
Voltage of both ends at C101 sometimes drop to 5V or less.
YES
NO
Malfunction of U101
• Malfunction of transformer
• Malfunction of C101
• Short-circuit of powersource line of +5V (Including malfunction of IC)
No function of data bus D0-D7 is found.
YES
Defective software of IC which data bus is connected to, which is out of control.
NO
Clock signals are input into U53-11.
YES
1
NO
A
U9-15 remains staying at "H".
YES
NO
Both U13-9 and 10 are not at "L".
YES
NO
Malfunction of U13
Address signals (A0 – A15) are clearly shown.
YES
• Malfunction of U9.
• Software runs away.
NO
• Malfunction of U6.
• Software runs away.
Clock signal (about 4.6 MHz) is output in U4-64.
YES
NO
Malfunction of C3, 4 and X1
U4-7 is "L".
YES
NO
Malfunction of U1, U5 and C5
Malfunction of U2, 3 and 4.

TROUBLESHOOTING

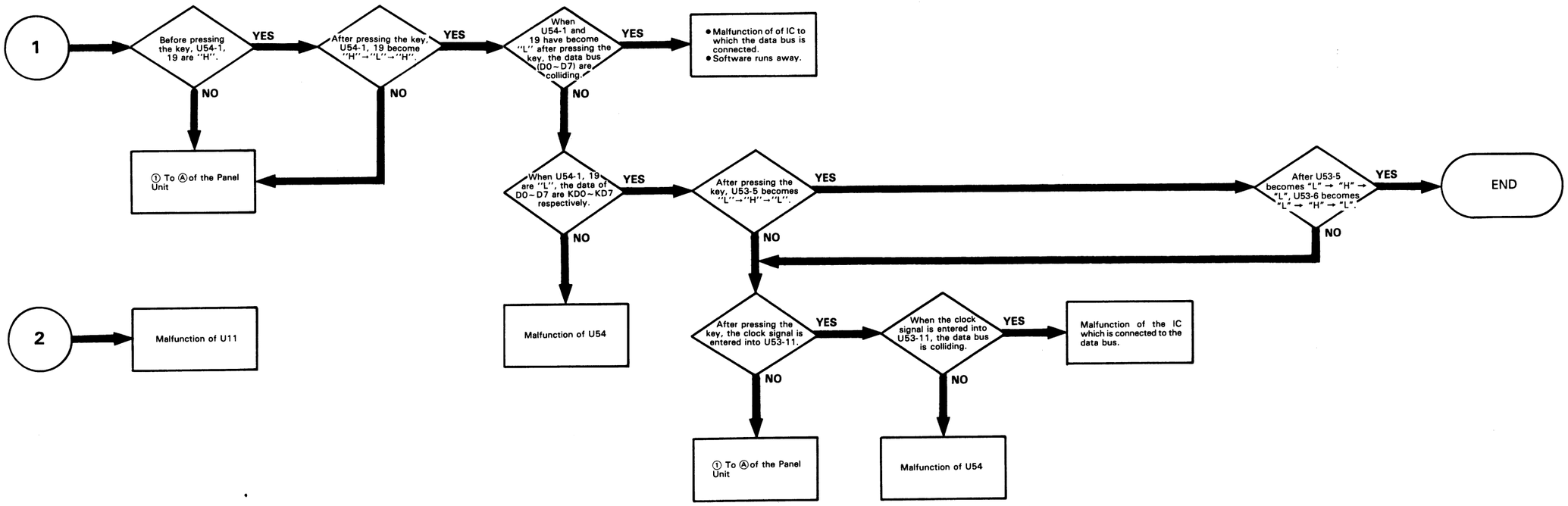

1
The signals of Q0~Q3 of U53 are the same as those of D0~D3 when the clock signals are sent to U53-11.
YES
Oscillating clock is caused in U51, 52-2.
YES
LED lighting signal is output from S1~S8 and T1~T5 of U51 and 52.
YES
The corrector electric potential of Q51~Q60 is always changing.
YES
END
NO
Malfunction of R83, and 84, C60 and 61
NO
Malfunction of U51 and 52.
NO
Malfunction of LED, Q51~Q60.
NO
The signals of Q0~Q3 of U53 are always constant, or incomplete electric potential.
YES
Malfunction of U53
NO
Software runs away.

TROUBLESHOOTING

Symptom: The operation requested by pressing a key does not occur.

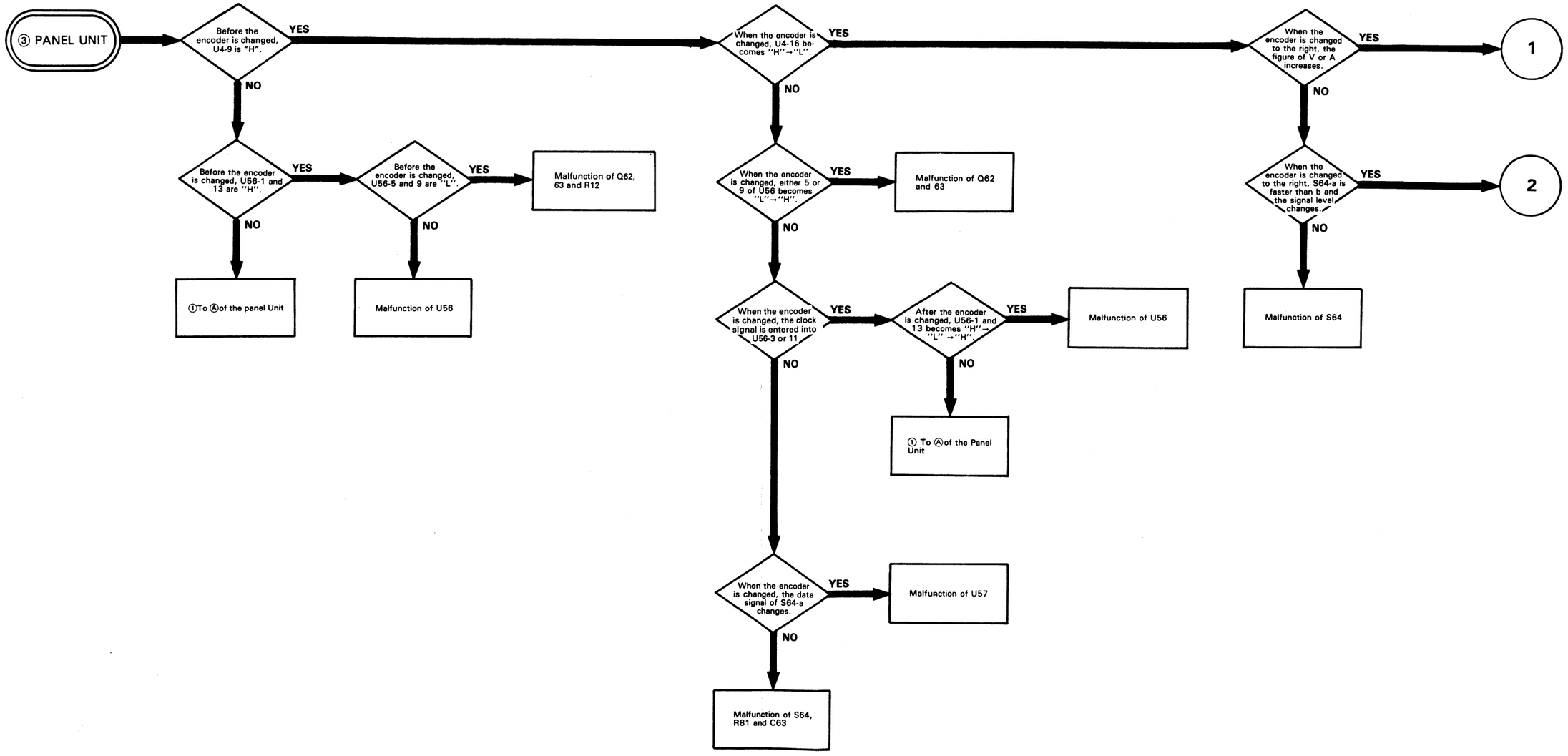


TROUBLESHOOTING

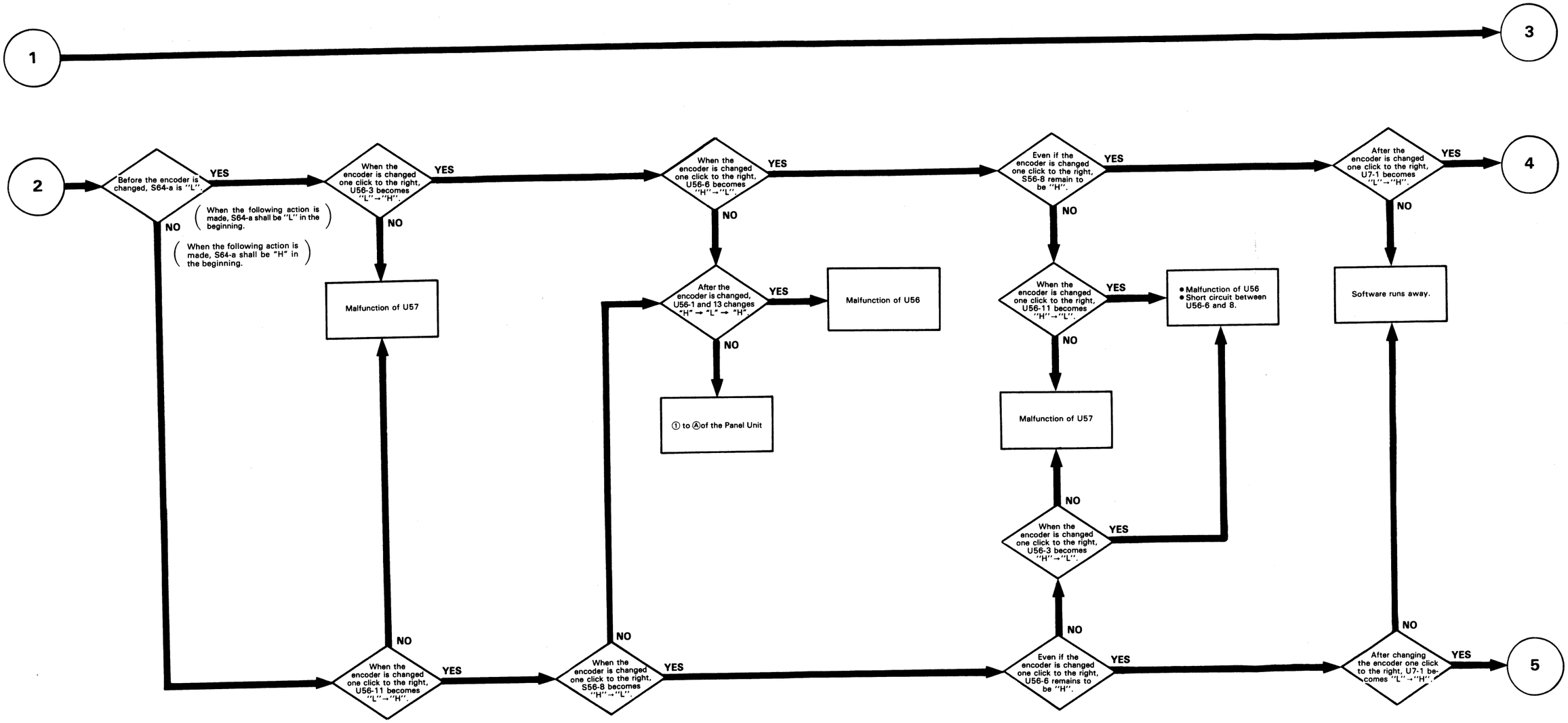

1
Before pressing the key, U54-1, 19 are "H".
YES
NO
After pressing the key, U54-1, 19 become "H"→"L"→"H".
YES
NO
When U54-1 and 19 have become "L" after pressing the key, the data bus (D0~D7) are colliding.
YES
NO
• Malfunction of of IC to which the data bus is connected.
• Software runs away.
① To Ⓐof the Panel Unit
When U54-1, 19 are "L", the data of D0~D7 are KD0~KD7 respectively.
YES
NO
After pressing the key, U53-5 becomes "L"→"H"→"L".
YES
NO
After U53-5 becomes "L" → "H" → "L", U53-6 becomes "L" → "H" → "L".
YES
NO
END
2
Malfunction of U11
Malfunction of U54
After pressing the key, the clock signal is entered into U53-11.
YES
NO
When the clock signal is entered into U53-11, the data bus is colliding.
YES
NO
Malfunction of the IC which is connected to the data bus.
① To Ⓐof the Panel Unit
Malfunction of U54

TROUBLESHOOTING

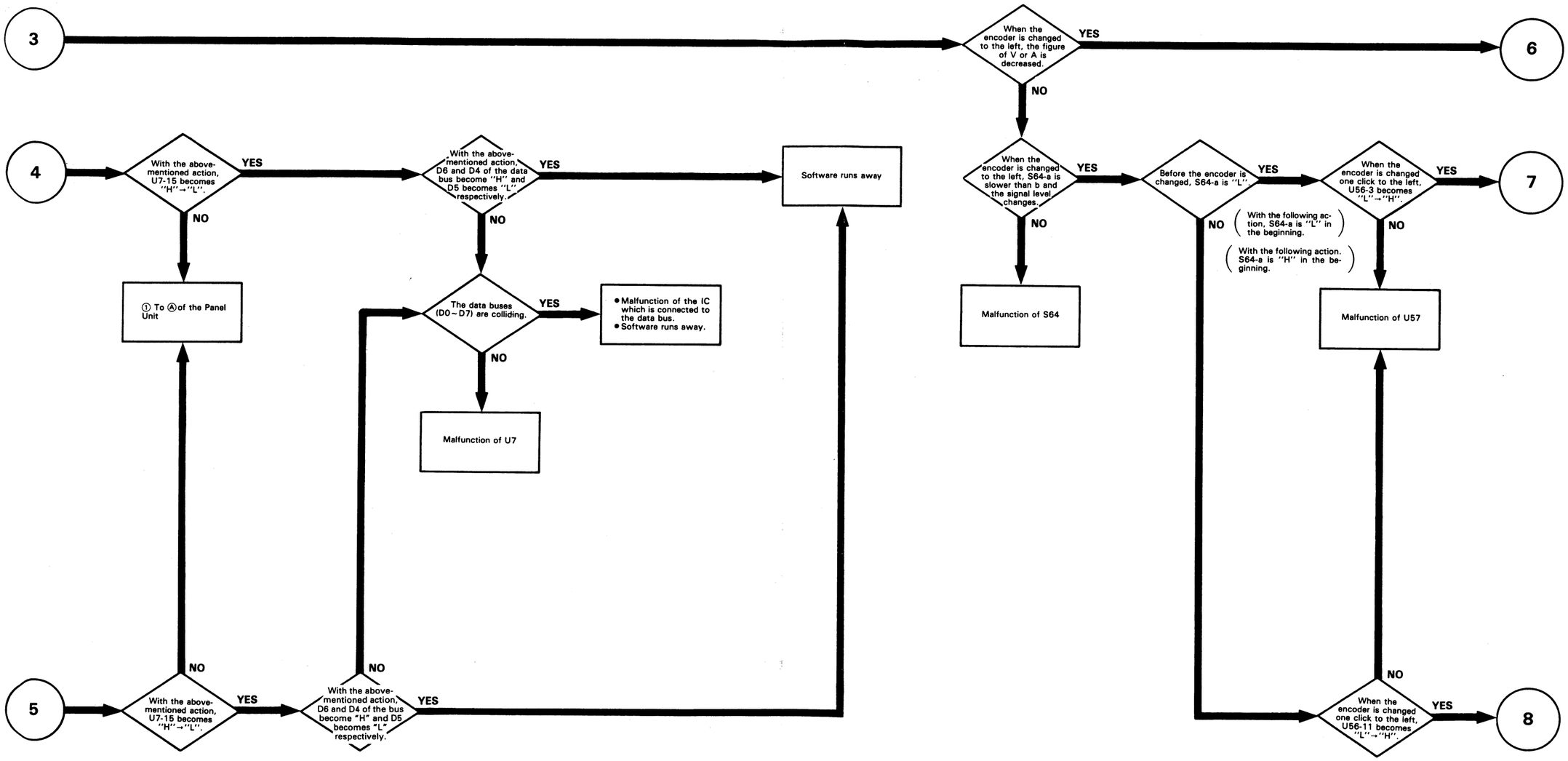
Symptom: When the V and A are varied with the encoder while the MEMORY LED is lit, the indicated V and A do not vary in accordance with the encoder operation.

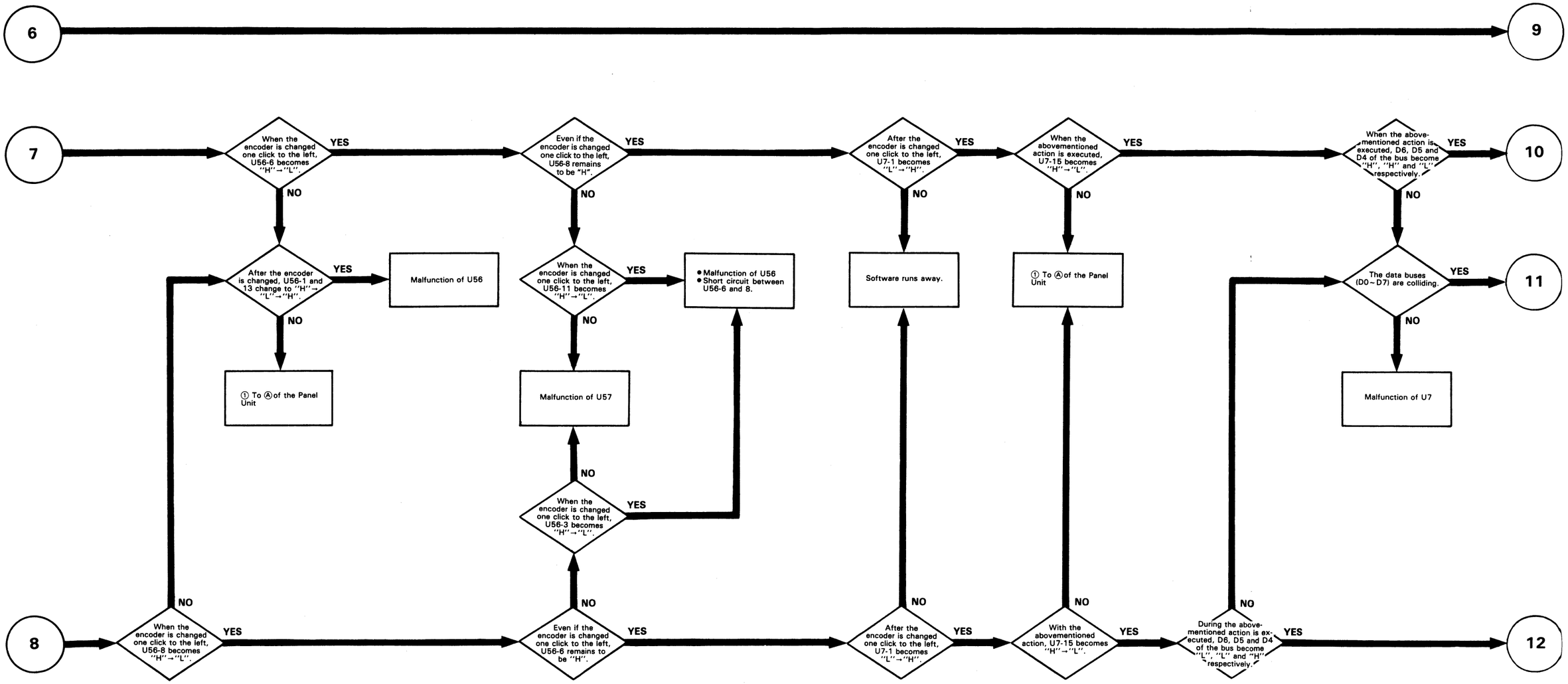

③ PANEL UNIT
Before the encoder is changed, U4-9 is "H".
YES
NO
Before the encoder is changed, U56-1 and 13 are "H".
YES
Before the encoder is changed, U56-5 and 9 are "L".
YES
Malfunction of Q62, 63 and R12
NO
①To Ⓐof the panel Unit
NO
Malfunction of U56
When the encoder is changed, U4-16 becomes "H"→"L".
YES
NO
When the encoder is changed, either 5 or 9 of U56 becomes "L"→"H".
YES
Malfunction of Q62 and 63
NO
When the encoder is changed, the clock signal is entered into U56-3 or 11
YES
After the encoder is changed, U56-1 and 13 becomes "H"→"L"→"H".
YES
Malfunction of U56
NO
① To Ⓐof the Panel Unit
NO
When the encoder is changed, the data signal of S64-a changes.
YES
Malfunction of U57
NO
Malfunction of S64, R81 and C63
When the encoder is changed to the right, the figure of V or A increases.
YES
1
NO
When the encoder is changed to the right, S64-a is faster than b and the signal level changes.
YES
2
NO
Malfunction of S64

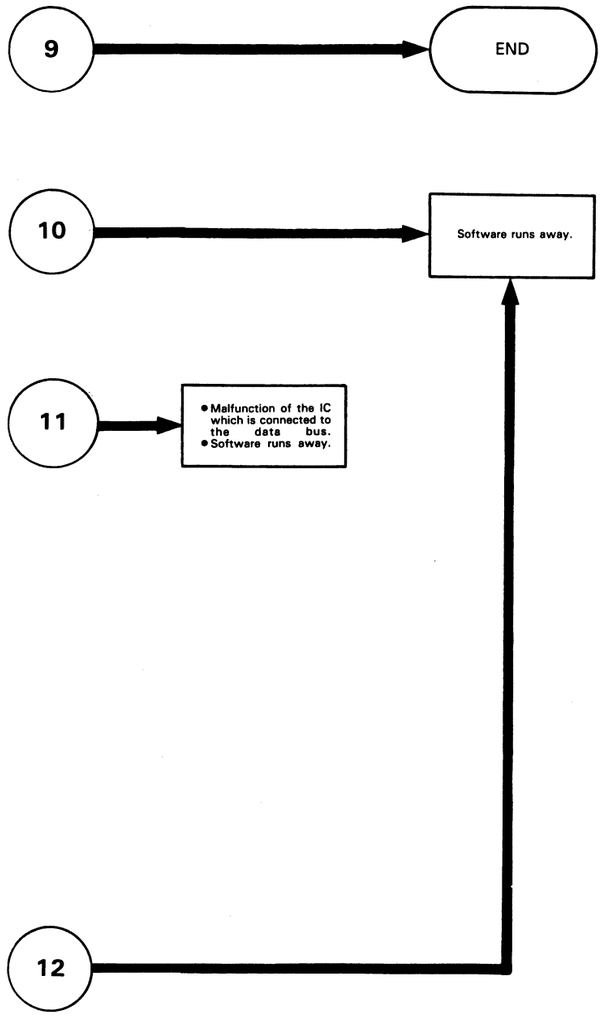
TROUBLESHOOTING


1
3
2
Before the encoder is changed, S64-a is "L".
YES
NO
(When the following action is made, S64-a shall be "L" in the beginning.)
(When the following action is made, S64-a shall be "H" in the beginning.)
When the encoder is changed one click to the right, U56-3 becomes "L"→"H".
YES
NO
Malfunction of U57
When the encoder is changed one click to the right, U56-6 becomes "H"→"L".
YES
NO
After the encoder is changed, U56-1 and 13 changes "H"→"L"→"H".
YES
NO
Malfunction of U56
① to Ⓐof the Panel Unit
Even if the encoder is changed one click to the right, S56-8 remain to be "H".
YES
NO
When the encoder is changed one click to the right, U56-11 becomes "H"→"L".
YES
NO
Malfunction of U57
When the encoder is changed one click to the right, U56-3 becomes "H"→"L".
YES
NO
● Malfunction of U56
● Short circuit between U56-6 and 8.
After the encoder is changed one click to the right, U7-1 becomes "L"→"H".
YES
NO
Software runs away.
When the encoder is changed one click to the right, U56-11 becomes "L"→"H".
YES
NO
When the encoder is changed one click to the right, S56-8 becomes "H"→"L".
YES
NO
Even if the encoder is changed one click to the right, U56-6 remains to be "H".
YES
NO
After changing the encoder one click to the right, U7-1 becomes "L"→"H".
YES
NO
4
5

TROUBLESHOOTING

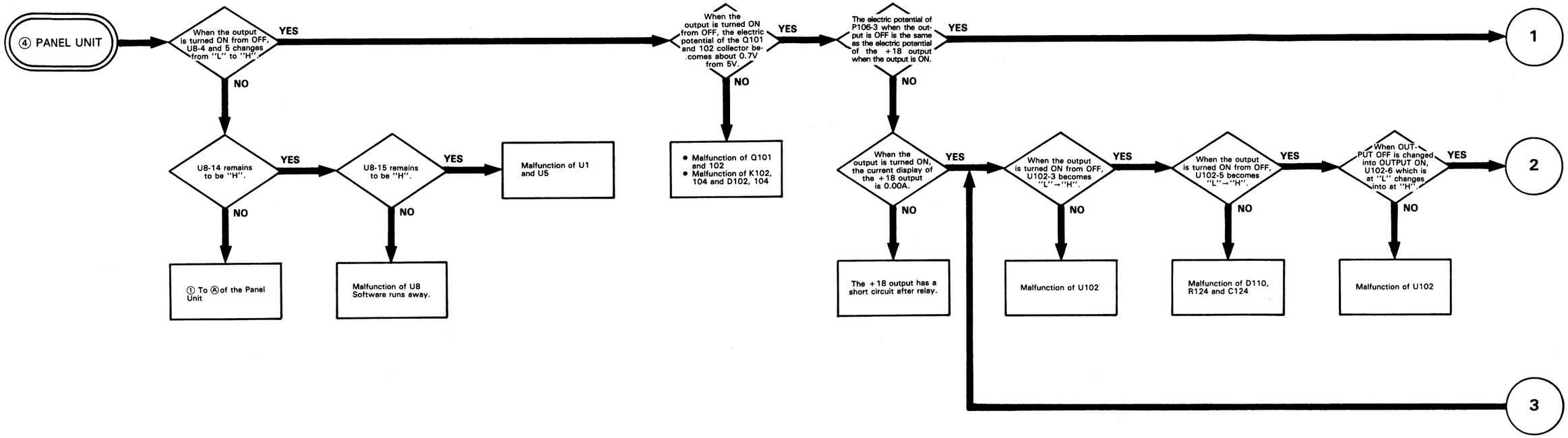

3
When the encoder is changed to the left, the figure of V or A is decreased.
YES
6
NO
4
With the above-mentioned action, U7-15 becomes "H"→"L".
YES
NO
With the above-mentioned action, D6 and D4 of the data bus become "H" and D5 becomes "L" respectively.
YES
NO
Software runs away
① To Ⓐ of the Panel Unit
The data buses (D0~D7) are colliding.
YES
NO
• Malfunction of the IC which is connected to the data bus.
• Software runs away.
Malfunction of U7
When the encoder is changed to the left, S64-a is slower than b and the signal level changes.
YES
NO
Malfunction of S64
Before the encoder is changed, S64-a is "L".
YES
NO
(With the following action, S64-a is "L" in the beginning.)
(With the following action. S64-a is "H" in the beginning.)
When the encoder is changed one click to the left, U56-3 becomes "L"→"H".
YES
NO
7
Malfunction of U57
5
With the above-mentioned action, U7-15 becomes "H"→"L".
NO
YES
With the above-mentioned action, D6 and D4 of the bus become "H" and D5 becomes "L" respectively.
NO
YES
When the encoder is changed one click to the left, U56-11 becomes "L"→"H".
NO
YES
8


6
9
7
When the encoder is changed one click to the left, U56-6 becomes "H"→"L".
YES
NO
After the encoder is changed, U56-1 and 13 change to "H"→"L"→"H".
YES
Malfunction of U56
NO
① To Ⓐ of the Panel Unit
Even if the encoder is changed one click to the left, U56-8 remains to be "H".
YES
NO
When the encoder is changed one click to the left, U56-11 becomes "H"→"L".
YES
• Malfunction of U56
• Short circuit between U56-6 and 8.
NO
Malfunction of U57
When the encoder is changed one click to the left, U56-3 becomes "H"→"L".
YES
NO
After the encoder is changed one click to the left, U7-1 becomes "L"→"H".
YES
NO
Software runs away.
When the abovementioned action is executed, U7-15 becomes "H"→"L".
YES
NO
① To Ⓐ of the Panel Unit
When the above-mentioned action is executed, D6, D5 and D4 of the bus become "H", "H" and "L" respectively.
YES
10
NO
The data buses (D0~D7) are colliding.
YES
11
NO
Malfunction of U7
8
When the encoder is changed one click to the left, U56-8 becomes "H"→"L".
YES
NO
Even if the encoder is changed one click to the left, U56-6 remains to be "H".
YES
NO
After the encoder is changed one click to the left, U7-1 becomes "L"→"H".
YES
NO
With the abovementioned action, U7-15 becomes "H"→"L".
YES
NO
During the above-mentioned action is executed, D6, D5 and D4 of the bus become "L", "L" and "H" respectively.
YES
12

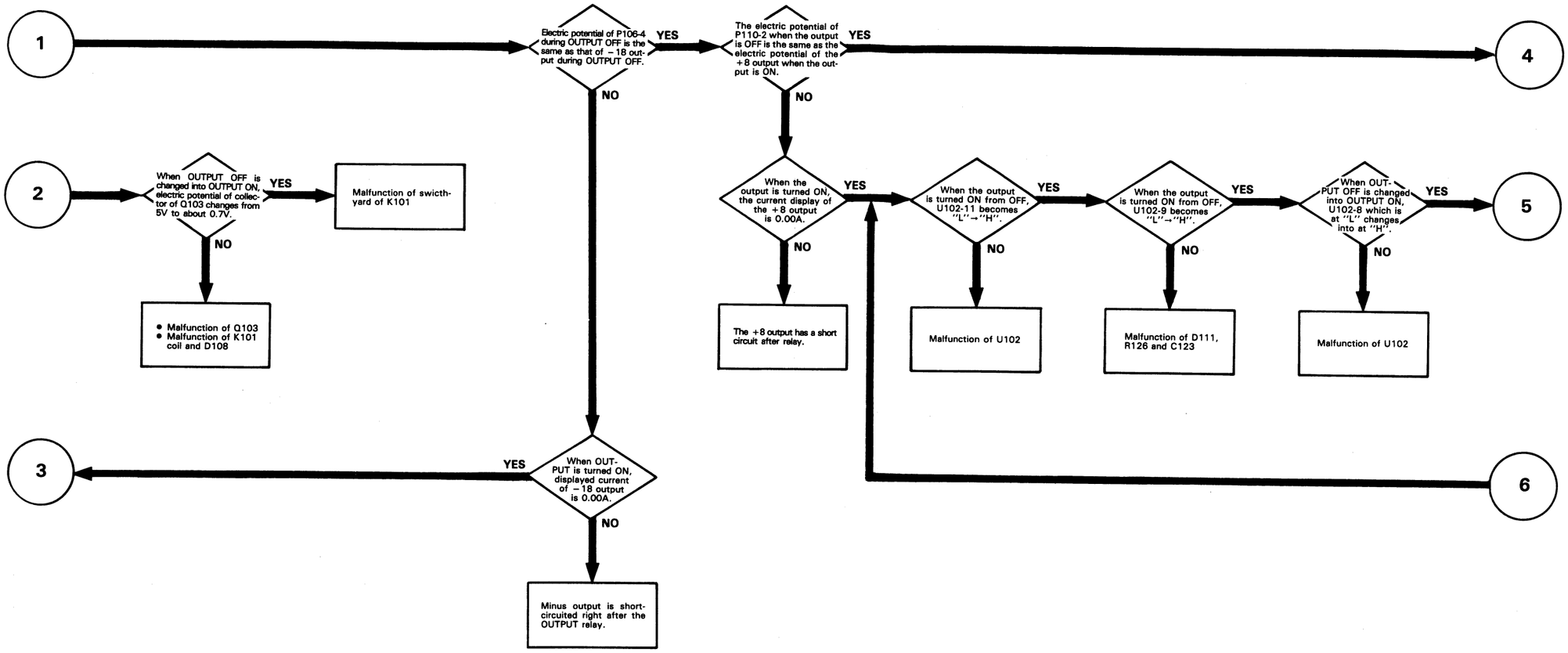

9
END
10
Software runs away.
11
• Malfunction of the IC which is connected to the data bus.
• Software runs away.
12

TROUBLESHOOTING

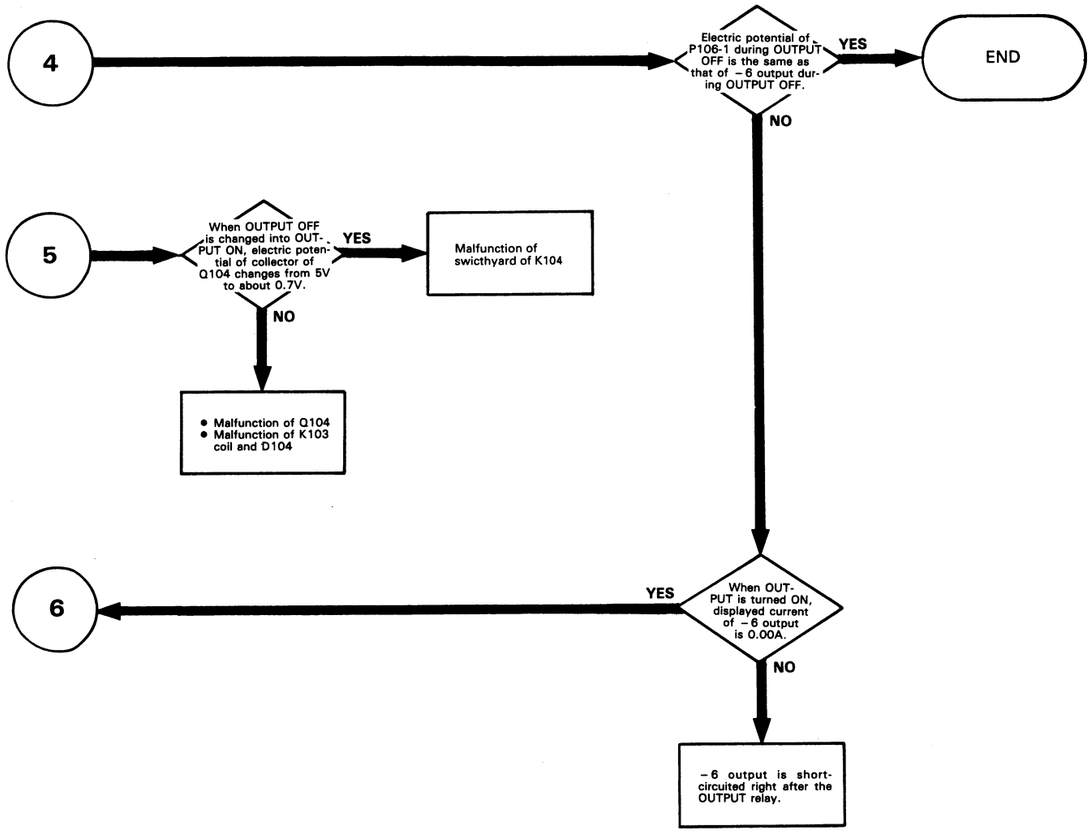
Symptom: When the OUTPUT is switched ON while there is no load, the output voltage is not as indicated by the voltage indication.


④ PANEL UNIT
When the output is turned ON from OFF, U8-4 and 5 changes from "L" to "H".
YES
NO
When the output is turned ON from OFF, the electric potential of the Q101 and 102 collector becomes about 0.7V from 5V.
YES
NO
The electric potential of P106-3 when the output is OFF is the same as the electric potential of the +18 output when the output is ON.
YES
NO
1
U8-14 remains to be "H".
YES
NO
U8-15 remains to be "H".
YES
NO
Malfunction of U1 and U5
① To Ⓐ of the Panel Unit
Malfunction of U8 Software runs away.
• Malfunction of Q101 and 102
• Malfunction of K102, 104 and D102, 104
When the output is turned ON, the current display of the +18 output is 0.00A.
YES
NO
When the output is turned ON from OFF, U102-3 becomes "L"→"H".
YES
NO
When the output is turned ON from OFF, U102-5 becomes "L"→"H".
YES
NO
When OUTPUT OFF is changed into OUTPUT ON, U102-6 which is at "L" changes into at "H".
YES
NO
2
The +18 output has a short circuit after relay.
Malfunction of U102
Malfunction of D110, R124 and C124
Malfunction of U102
3

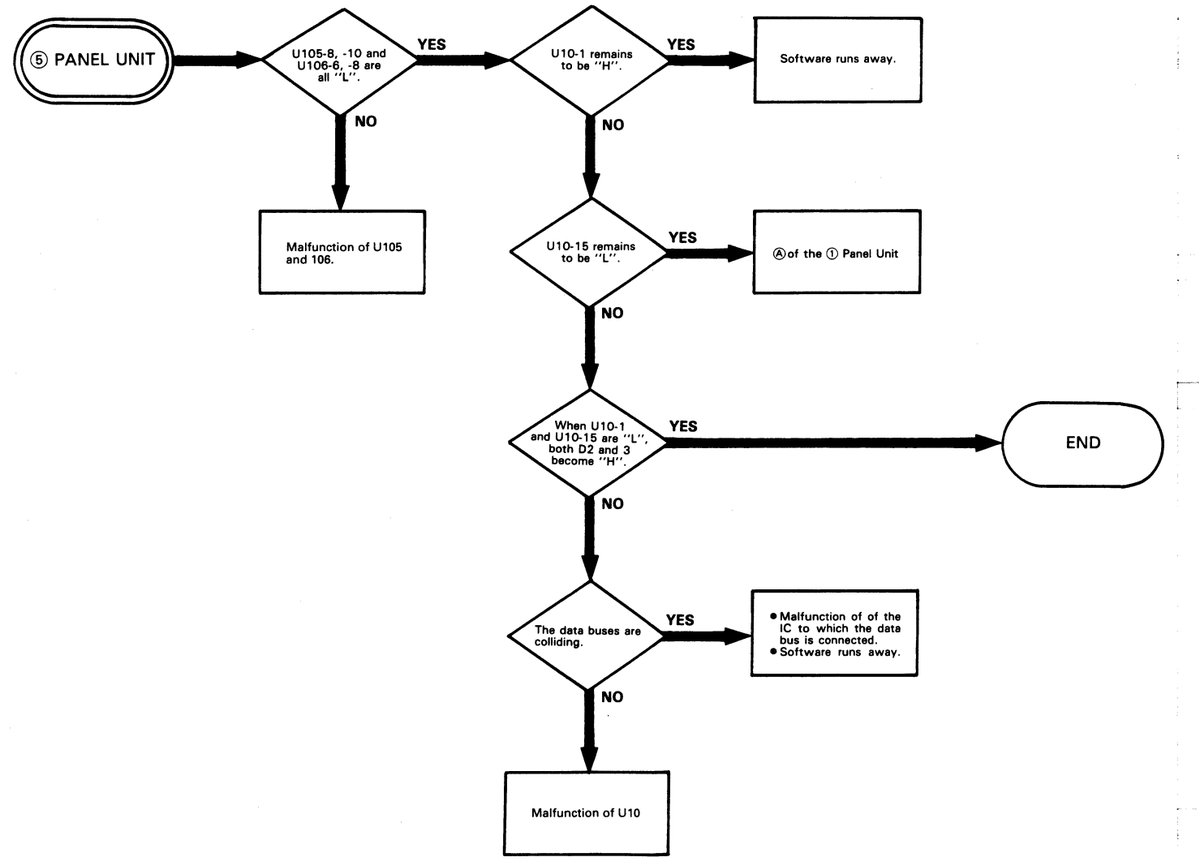
TROUBLESHOOTING


1
Electric potential of P106-4 during OUTPUT OFF is the same as that of – 18 output during OUTPUT OFF.
YES
The electric potential of P110-2 when the output is OFF is the same as the electric potential of the +8 output when the output is ON.
YES
4
NO
NO
2
When OUTPUT OFF is changed into OUTPUT ON, electric potential of collector of Q103 changes from 5V to about 0.7V.
YES
Malfunction of swicthyard of K101
NO
• Malfunction of Q103
• Malfunction of K101 coil and D108
When the output is turned ON, the current display of the +8 output is 0.00A.
YES
When the output is turned ON from OFF, U102-11 becomes "L"→"H".
YES
When the output is turned ON from OFF, U102-9 becomes "L"→"H".
YES
When OUTPUT OFF is changed into OUTPUT ON, U102-8 which is at "L" changes into at "H".
YES
5
NO
NO
NO
NO
The +8 output has a short circuit after relay.
Malfunction of U102
Malfunction of D111, R126 and C123
Malfunction of U102
3
YES
When OUTPUT is turned ON, displayed current of – 18 output is 0.00A.
NO
Minus output is short-circuited right after the OUTPUT relay.
6

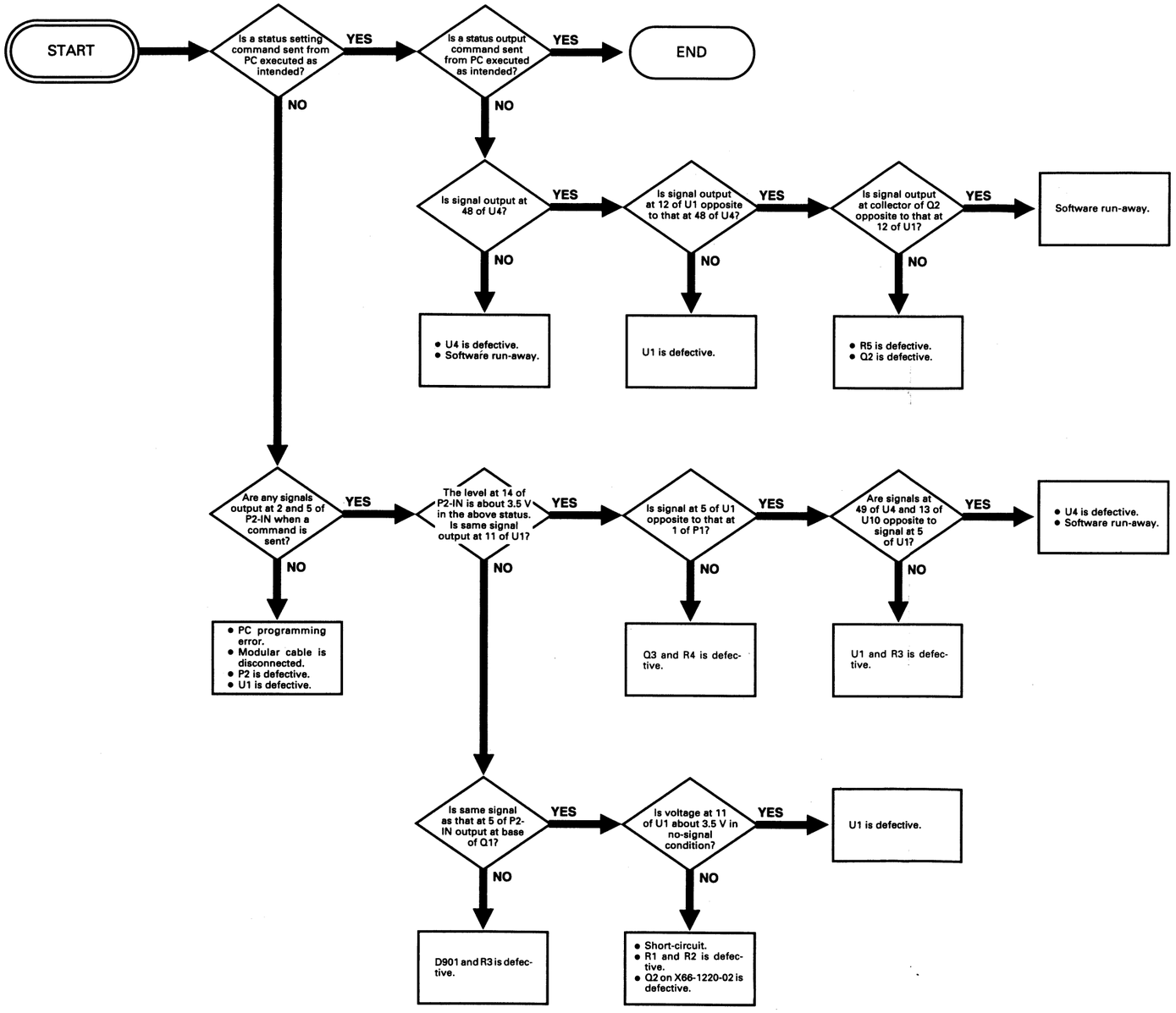
TROUBLESHOOTING


4
Electric potential of P106-1 during OUTPUT OFF is the same as that of −6 output during OUTPUT OFF.
YES
END
NO
5
When OUTPUT OFF is changed into OUTPUT ON, electric potential of collector of Q104 changes from 5V to about 0.7V.
YES
Malfunction of swicthyard of K104
NO
• Malfunction of Q104
• Malfunction of K103 coil and D104
6
When OUTPUT is turned ON, displayed current of −6 output is 0.00A.
YES
NO
−6 output is short-circuited right after the OUTPUT relay.

Symptom: When both outputs are used in CC state, the ±18 , +8, −6 LEDs do not blink.



TROUBLESHOOTING


START
Is a status setting command sent from PC executed as intended?
YES
NO
Is a status output command sent from PC executed as intended?
YES
END
NO
Is signal output at 48 of U4?
YES
NO
• U4 is defective.
• Software run-away.
Is signal output at 12 of U1 opposite to that at 48 of U4?
YES
NO
U1 is defective.
Is signal output at collector of Q2 opposite to that at 12 of U1?
YES
NO
• R5 is defective.
• Q2 is defective.
Software run-away.
Are any signals output at 2 and 5 of P2-IN when a command is sent?
YES
NO
• PC programming error.
• Modular cable is disconnected.
• P2 is defective.
• U1 is defective.
The level at 14 of P2-IN is about 3.5 V in the above status. Is same signal output at 11 of U1?
YES
NO
Is signal at 5 of U1 opposite to that at 1 of P1?
YES
NO
Q3 and R4 is defective.
Are signals at 49 of U4 and 13 of U10 opposite to signal at 5 of U1?
YES
NO
U1 and R3 is defective.
• U4 is defective.
• Software run-away.
Is same signal as that at 5 of P2-IN output at base of Q1?
YES
NO
D901 and R3 is defective.
Is voltage at 11 of U1 about 3.5 V in no-signal condition?
YES
NO
• Short-circuit.
• R1 and R2 is defective.
• Q2 on X66-1220-02 is defective.
U1 is defective.

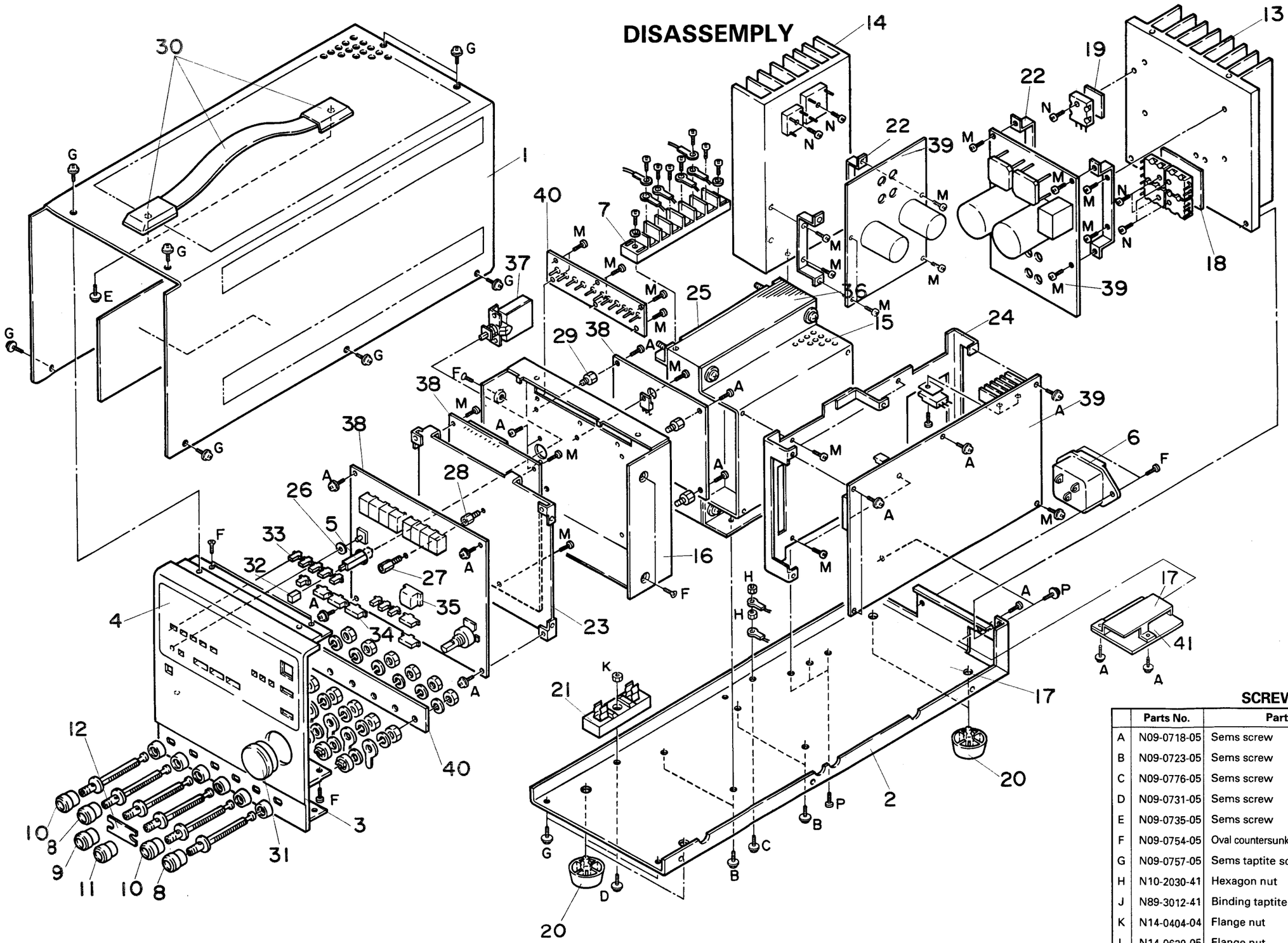
PARTS LIST

PWR18-1.8Ω UNIT

Y86-1470-00

REF. NO	PARTS NO	NAME & DESCRIPTION
	B40-2737-24	SERIAL NO. PLATE
	B41-0841-14	AC100V 50/60HZ 213W
	B41-0842-04	AC120V 50/60HZ 213W
	B41-0843-04	AC220V 50/60HZ 215W
	B41-0844-04	AC240V 50/60HZ 215W
	B41-0845-04	AC120V 60HZ 213W
	B41-0848-04	FUSE RATING LABEL
	B42-3743-04	REMOTE LABEL
	B63-0029-00	INSTRUCTION MANUAL;JAPANESE
	B63-0030-00	INSTRUCTION MANUAL;ENGLISH
	B63-0053-20	REMOTE MANUAL;JAPANESE
	B63-0054-20	REMOTE MANUAL;ENGLISH
	C90-0298-05	CAP. CERAMIC 0.1 20% 12V
	E30-1929-05	BS POWER CORD
	E30-1950-05	JIS POWER CORD
	E30-1951-05	UL/CSA POWER CORD
	E30-1952-05	CEE POWER CORD
	E30-1953-05	SAA POWER CORD
	E31-5811-15	WIRE ASS'Y;PIERCED CAP. TO CPU
	E31-5812-15	WIRE ASS'Y;PIERCED CAP. TO CPU
	E31-5813-15	WIRE ASS'Y
	E31-5815-15	WIRE ASS'Y;PIERCED CAP. TO CPU
	E31-5859-25	WIRE ASS'Y;AC PRIMARY
	E31-5860-15	WIRE ASS'Y;OUTPUT TERMINAL
	E31-5861-05	WIRE ASS'Y;P103 TO PIERCED CAP
	E31-5862-05	WIRE ASS'Y;CHANGING VOLTAGE
	E31-5863-15	WIRE ASS'Y;PIERCED CAP. TO CPU
	E38-0151-05	WIRE ASS'Y;CONTROLED COMMUNI.
	E38-0153-05	WIRE ASS'Y;COMMUNICATION CABLE
	F51-0004-05	FUSE(6X32MM) T3A/250V
	F51-0005-05	FUSE(6X32MM) T1.5A/250V
	H10-2846-12	FOAMED STYRENE PAD;FRONT
	H10-2847-02	FOAMED STYRENE PAD;REAR
	H20-1743-04	VINYL COVER
	H53-0024-04	CARTON BOX
	NJM7805FA	IC,3-TERMINAL REGULATOR
	N17-1030-41	LOCK WASHER M3
	N18-0712-04	WASHER D=7,M3
	N18-0728-04	WASHER D=10,M3
	2SA1301(R)	TR. SI, PNP
	2SA1302(R)	TR. SI, PNP
	2SC3280(R)	TR. SI, NPN
	2SC3281(R)	TR. SI, NPN
D57	S10VB20	DIODE,BRIDGE
D58	S4VB20	DIODE,BRIDGE
1	A01-1226-02	CASE
2	A10-1460-22	CHASSIS
3	A63-0018-03	FRONT PANEL
4	B11-0524-03	FILTER
5	D21-0926-04	EXTENSION SHAFT
6	E18-0351-05	AC INLET
7	E70-0611-05	TERMINAL BLOCK;TRANS
8	E21-0670-03	TERMINAL;RED
9	E21-0671-03	TERMINAL;BLACK
10	E21-0672-03	TERMINAL;WHITE
11	E21-0673-03	TERMINAL;BULE
12	E28-0506-04	SHORTING BAR
13	F01-0877-03	HEAT SINK
14	F01-0878-03	HEAT SINK
15	F10-1626-03	SHIELD PLATE
16	F11-1240-13	SHIELD CASE
17	J21-4725-04	BRACKET;BUFFER UNIT
18	F20-0689-05	INSULATOR
19	F20-0692-05	INSULATOR
20	J02-0323-05	RUBBER FOOT
21	J13-0038-05	FUSE HOLDER
22	J21-4678-04	BRACKET;P.C.B
23	J21-4697-03	BRACKET;SHIELD CASE
24	J21-4698-03	BRACKET
25	J21-4700-24	BRACKET;TERMINAL
26	J30-0632-04	SPACER
27	J32-0122-04	BOSS L=8
28	J32-0893-04	BOSS L=5.5
29	J32-0894-04	BOSS L=7.5
30	K01-0544-05	HANDLE
31	K21-0907-14	KNOB
32	K27-0509-04	PUSH BUTTON;POWER,ORANGE
33	K27-0555-04	BUTTON;SMALL
34	K27-0556-04	BUTTON;LARGE
35	K27-0557-04	BUTTON;OUTPUT,RED
36	L01-8946-25	POWER TRANSFORMER
37	S40-2524-05	PUSH SWITCH;POWER
38	X66-1220-02	PANEL UNIT
39	X73-1890-01	AMP UNIT
40	X81-2880-03	TERMINAL UNIT
41	X81-2890-00	BUFFER UNIT

DISASSEMPLY



SCREWS

	Parts No.	Parts Name		Figure
A	N09-0718-05	Sems screw	(M3 × 6)	
B	N09-0723-05	Sems screw	(M5 × 10)	
C	N09-0776-05	Sems screw	(M3 × 16)	
D	N09-0731-05	Sems screw	(M3 × 12)	
E	N09-0735-05	Sems screw	(M4 × 6)	
F	N09-0754-05	Oval countersunk head screw	(3 × 8)	
G	N09-0757-05	Sems taptite screw	(3 × 6)	
H	N10-2030-41	Hexagon nut	(M3)	
J	N89-3012-41	Binding taptite screw	(3 × 12)	
K	N14-0404-04	Flange nut	(M3)	
L	N14-0620-05	Flange nut	(M4)	
M	N89-3006-41	Binding taptite screw	(3 × 6)	
N	N89-3010-41	Binding taptite screw	(3 × 10)	
P	N09-0739-05	Sems taptite screw	(3 × 8)	

PARTS LIST

PANEL UNIT

X66-1220-02

REF.NO	PARTS NO	NAME & DESCRIPTION
	E31-5841-05	WIRE ASS'Y;JW101 TO NJM7805FA
	E31-5870-05	WIRE ASS'Y;JW1 TO P52
	E31-5872-05	WIRE ASS'Y;JW2 TO P52
	J73-0155-12	PCB (UNMOUNTED)
C1	CE04EW1A471M	CAP. ELECTRO 470 20% 10V
C2	CE04EW1A471M	CAP. ELECTRO 470 20% 10V
C3	CC45CH1H100D	CAP. CERAMIC 10P 0.5% 50V
C4	CC45CH1H100D	CAP. CERAMIC 10P 0.5% 50V
C5	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C6	C91-1310-05	CAP. DOUBLE 0.1 80/-20% 5.5
C7	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C8	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C9	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C10	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C11	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C12	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C13	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C14	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C15	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C16	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C17	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C18	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C51	CE04EW1A221M	CAP. ELECTRO 220 20% 10V
C52	CE04EW1A221M	CAP. ELECTRO 220 20% 10V
C53	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C54	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C55	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C56	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C57	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C58	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C59	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C60	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C61	CC45CH1H101J	CAP. CERAMIC 100P 5% 50V
C101	C90-3008-05	CAP. ELECTRO 3900 20% 16V
C102	CE04EW1A471M	CAP. ELECTRO 470 20% 10V
C103	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C104	CE04EW1A101M	CAP. ELECTRO 100 20% 10V
C105	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C106	CE04EW1A101M	CAP. ELECTRO 100 20% 10V
C123	CF92V1H104J	CAP. POLYESTER 0.1 5% 50V
C124	CF92V1H104J	CAP. POLYESTER 0.1 5% 50V
C125	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C126	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
D1	MA700	DIODE
D2	MA700	DIODE
D51	B30-0874-05	LED;7-SEGMENTS
D52	B30-0874-05	LED;7-SEGMENTS
D53	B30-0874-05	LED;7-SEGMENTS
D54	B30-0874-05	LED;7-SEGMENTS
D55	B30-0874-05	LED;7-SEGMENTS
D56	B30-0874-05	LED;7-SEGMENTS
D57	B30-0874-05	LED;7-SEGMENTS
D58	B30-0874-05	LED;7-SEGMENTS
D59	B30-0894-05	LED;RED
D60	B30-0895-05	LED;GREEN/YELLOW
D61	NO USE	
D62	B30-0895-05	LED;GREEN/YELLOW
D63	B30-0895-05	LED;GREEN/YELLOW
D64	B30-0895-05	LED;GREEN/YELLOW
D65	B30-0894-05	LED;RED
D66	B30-0886-05	LED;GREEN/YELLOW AND RED
D67	B30-0894-05	LED;RED
D68	B30-0895-05	LED;GREEN/YELLOW
D69	B30-0895-05	LED;GREEN/YELLOW
D70	B30-0895-05	LED;GREEN/YELLOW
D71	B30-0886-05	LED;GREEN/YELLOW AND RED
D72	B30-0895-05	LED;GREEN/YELLOW
D73	B30-0895-05	LED;GREEN/YELLOW
D74	B30-0895-05	LED;GREEN/YELLOW
D101	S1VB20	DIODE,BRIDGE
D102	1SS132	DIODE
D103	1SS132	DIODE
D104	S3V10	DIODE
D105	S3V10	DIODE
D106	S3V10	DIODE
D107	S3V10	DIODE
D108	1SS132	DIODE
D109	1SS132	DIODE
D110	1SS132	DIODE
D111	1SS132	DIODE
K101	S51-2508-05	RELAY
K102	S51-2511-05	RELAY
K103	S51-2508-05	RELAY
K104	S51-2511-05	RELAY
L1	L40-4701-03	FERRI INDUCTOR 47UH
L51	L40-4701-03	FERRI INDUCTOR 47UH
P1	E40-3237-05	PIN CONNECTOR 2P
P4	E40-5067-05	PIN CONNECTOR 10P
P5	E40-3237-05	PIN CONNECTOR 2P
P51	E40-3237-05	PIN CONNECTOR 2P
P101	E40-3237-05	PIN CONNECTOR 2P
P102	E40-3239-05	PIN CONNECTOR 4P
P103	E40-5067-05	PIN CONNECTOR 10P
P106	E40-3239-05	PIN CONNECTOR 4P
P107	NO USE	
P108	E40-4248-05	PIN CONNECTOR 2P
P109	E40-3911-05	PIN CONNECTOR 3P
P110	E40-3239-05	PIN CONNECTOR 4P
P111	NO USE	
P112	E40-4248-05	PIN CONNECTOR 2P
P113	E40-4248-05	PIN CONNECTOR 2P
Q1	2SC2785(F)	TR. SI, NPN
Q2	2SC2785(F)	TR. SI, NPN
Q3	2SC2785(F)	TR. SI, NPN
Q51	2SC2785(F)	TR. SI, NPN
Q52	2SC2785(F)	TR. SI, NPN
Q53	2SC2785(F)	TR. SI, NPN
Q54	2SC2785(F)	TR. SI, NPN
Q55	2SC2785(F)	TR. SI, NPN
Q56	2SC2785(F)	TR. SI, NPN
Q57	2SC2785(F)	TR. SI, NPN
Q58	2SC2785(F)	TR. SI, NPN
Q59	2SC2785(F)	TR. SI, NPN
Q60	2SC2785(F)	TR. SI, NPN
Q61	NO USE	
Q62	2SC2785(F)	TR. SI, NPN
Q63	2SC2785(F)	TR. SI, NPN
Q64	2SA1175(F)	TR. SI, PNP
Q65	2SA1175(F)	TR. SI, PNP
Q101	2SC1815(Y)	TR. SI, NPN
Q102	2SC1815(Y)	TR. SI, NPN
Q103	2SC1815(Y)	TR. SI, NPN
Q104	2SC1815(Y)	TR. SI, NPN
R1	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R2	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R3	RD14BB2C222J	RES. CARBON 2.2K 5% 1/6W
R4	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R5	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R6	R90-0612-05	RES. NETWORK 4.7KX8
R7	R90-0612-05	RES. NETWORK 4.7KX8
R8	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R9	RD14BB2C751J	RES. CARBON 750 5% 1/6W
R51	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R52	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R53	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R54	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R55	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R56	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R57	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R58	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R59	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R60	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R61	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R62	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R63	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R64	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R65	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R66	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R67	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R68	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R69	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R70	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R71	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R72	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R73	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R74	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R75	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R76	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R79	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R80	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R81	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R82	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R83	RD14BB2C104J	RES. CARBON 100K 5% 1/6W
R84	RD14BB2C104J	RES. CARBON 100K 5% 1/6W
R85	R90-0612-05	RES. NETWORK 4.7KX8
R86	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R87	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R88	RD14BB2C472J	RES. CARBON 4.7K 5% 1/6W
R89	RD14BB2C151J	RES. CARBON 150 5% 1/6W
R100	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R101	RD14BB2C361J	RES. CARBON 360 5% 1/6W
R102	RD14BB2C361J	RES. CARBON 360 5% 1/6W
R103	RD14BB2C361J	RES. CARBON 360 5% 1/6W
R104	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R105	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R106	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R107	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R108	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R109	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R110	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R111	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R112	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R113	RD14BB2C431J	RES. CARBON 430 5% 1/6W
R117	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R118	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R119	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R122	RD14BB2E220J	RES. CARBON 22 5% 1/4W
R123	RD14BB2E220J	RES. CARBON 22 5% 1/4W
R124	RD14BB2C154J	RES. CARBON 150K 5% 1/6W
R125	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R126	RD14BB2C154J	RES. CARBON 150K 5% 1/6W
R127	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R128	NO USE	
R129	RD14BB2E220J	RES. CARBON 22 5% 1/4W
R134	RD14BB2E220J	RES. CARBON 22 5% 1/4W
R140	RN14BK2C3901F	RES. METAL FILM 3.9K 1% 1/6W
R141	RN14BK2C1002F	RES. METAL FILM 10K 1% 1/6W
S1	S50-1426-05	TACT SWITCH
S2	S50-1426-05	TACT SWITCH
S3	S50-1426-05	TACT SWITCH
S4	S50-1426-05	TACT SWITCH
S5	S50-1426-05	TACT SWITCH
S6	S50-1426-05	TACT SWITCH
S7	S50-1426-05	TACT SWITCH
S8	S50-0503-05	TACT SWITCH
S9	S50-1426-05	TACT SWITCH
S60	S50-1426-05	TACT SWITCH
S61	S50-1426-05	TACT SWITCH
S62	S50-1426-05	TACT SWITCH
S63	S50-1426-05	TACT SWITCH
S64	W02-1762-05	ROTARY ENCORDER
S65	S50-1426-05	TACT SWITCH
S66	S50-1426-05	TACT SWITCH
S67	S50-1426-05	TACT SWITCH
U1	TC74HC14AP	IC,HEX SCHMITT INVERTER
U2	T93-0721-14	IC,PROGRAMMED ROM
U3	HM6264ALP-15L	IC,C-MOS STATIC RAM
U4	HD64180R1P6	IC,CPU
U5	MB3773P-G	IC,RESET
U6	TC74HC139AP	IC,DUAL 2 TO 4 LINE DECODER
U7	TC74HC257AP	IC,QUAD 2-CHANNEL MPX(3-STATE)
U8	TC74HC259AP	IC,8-BIT ADDRESSABLE LATCH
U9	TC74HC139AP	IC,DUAL 2 TO 4 LINE DECODER
U10	TC74HC257AP	IC,QUAD 2-CHANNEL MPX(3-STATE)
U11	TC74HC74AP	IC,DUAL D-FLIP FLOP
U12	NO USE	
U13	TC74HC32AP	IC,QUAD 2-INPUT OR GATE
U51	TC9181P	IC,DRIVER
U52	TC74HC541AP	IC,OCTAL BUS BUFFER (3-STATE)
U53	TC74HC374AP	IC,OCTAL 3-STATE D-FFS
U54	TC9191P	IC,DRIVER
U55	TC74HC30AP	IC,8-INPUT NAND GATE
U56	TC74HC74AP	IC,DUAL D-FLIP FLOP
U57	TC74HC14AP	IC,HEX SCHMITT INVERTER
U102	TC74HC125AP	IC,QUAD 3 STATE BUS BUFFERS
U103	PC837	IC,PHOTO COUPLER
U104	NO USE	
U105	PC837	IC,PHOTO COUPLER
U106	PC827	IC,PHOTO COUPLER
X1	L78-0114-05	CERAMIC OSCILLATOR(9.210MHZ)

AMP UNIT

X73-1890-01

REF.NO	PARTS NO	NAME & DESCRIPTION
	E38-0024-15	WIRE ASS'Y;JW3 TO 2SC3280
	E38-0108-05	WIRE ASS'Y;P14 TO JW2.ETC.
	F02-0520-05	HEAT SINK
	J25-5395-32	PCB (UNMOUNTED)
	N09-0626-04	SCREW,SEMS PAN HD M3X10
C1	C90-3009-05	CAP. ELECTRO 2700 20% 25V
C2	C90-3009-05	CAP. ELECTRO 2700 20% 25V
C3	CE04EW1C331M	CAP. ELECTRO 330 20% 16V
C4	CE04EW1C221M	CAP. ELECTRO 220 20% 16V
C5	CE04EW1H2R2M	CAP. ELECTRO 2.2 20% 50V
C6	CE04EW1H2R2M	CAP. ELECTRO 2.2 20% 50V
C7	CE04EW1H2R2M	CAP. ELECTRO 2.2 20% 50V
C8	CE04EW1H2R2M	CAP. ELECTRO 2.2 20% 50V
C9	CE04EW1A101M	CAP. ELECTRO 100 20% 10V
C10	CE04EW1A101M	CAP. ELECTRO 100 20% 10V
C11	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C12	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C13	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C14	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C15	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C16	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C17	NO USE	
C18	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C19	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C20	C91-1128-05	CAP. CERAMIC 0.1 80/-20% 50V
C21	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C22	CF92V1H105J	CAP. POLYESTER 1P 5% 50V
C23	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C24	CF92V1H105J	CAP. POLYESTER 1P 5% 50V
C25	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C26	CF92V1H105J	CAP. POLYESTER 1P 5% 50V
C27	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C28	CF92V1H105J	CAP. POLYESTER 1P 5% 50V
C29	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C38	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C39	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C40	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C41	CF92V1H474J	CAP. POLYESTER 0.47 5% 50V
C44	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C45	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C46	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C47	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C48	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C49	CE04EW1C100M	CAP. ELECTRO 10 20% 16V
C50	NO USE	
C51	C90-3017-05	CAP. ELECTRO 6800 20% 50V
C52	C90-3017-05	CAP. ELECTRO 6800 20% 50V
C53	C90-0973-05	CAP. ELECTRO 6800 20% 25V
C54	C90-0986-05	CAP. ELECTRO 4700 20% 25V
C65	CE04EW1E470M	CAP. ELECTRO 47 20% 25V
C66	CE04EW1E470M	CAP. ELECTRO 47 20% 25V
C67	CE04EW1E470M	CAP. ELECTRO 47 20% 25V
C68	CE04EW1E470M	CAP. ELECTRO 47 20% 25V
C69	CF83AN2E104K	CAP. POLYESTER 0.1 10% 250V
C70	CF83AN2E104K	CAP. POLYESTER 0.1 10% 250V
C71	CF83AN2E104K	CAP. POLYESTER 0.1 10% 250V
C72	CF83AN2E104K	CAP. POLYESTER 0.1 10% 250V
C73	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C74	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C75	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C76	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C77	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C78	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C79	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C80	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C81	CK45FF1H103Z	CAP. CERAMIC 0.01 10% 50V
C90	C91-2586-05	CAP. CERAMIC 1000P 500V
C91	C91-2586-05	CAP. CERAMIC 1000P 500V
D1	S1VB20	DIODE,BRIDGE
D2	MTZ9.1JC	DIODE,ZENER
D3	HZT7A3	DIODE,ZENER
D4	MTZ5.1JA	DIODE,ZENER
D5	1SS132	DIODE
D6	1SS132	DIODE
D7	1SS132	DIODE
D8	1SS132	DIODE
D9	1SS132	DIODE
D10	1SS132	DIODE
D11	1SS132	DIODE
D12	1SS132	DIODE
D13	1SS132	DIODE
D14	1SS132	DIODE
D15	1SS132	DIODE
D16	1SS132	DIODE
D17	1SS132	DIODE
D18	NO USE	
D19	1SS132	DIODE
D20	1SS132	DIODE

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION
D21	1SS132	DIODE
D22	1SS132	DIODE
D23	1SS132	DIODE
D24	1SS132	DIODE
D25	1SS132	DIODE
D26	1SS132	DIODE
D27	1SS132	DIODE
D28	1SS132	DIODE
D51	S10VB20F1	DIODE,BRIDGE
D52	S10VB20F1	DIODE,BRIDGE
D53	1SS132	DIODE
D54	1SS132	DIODE
D55	DSN1D2	DIODE
D56	DSN1D2	DIODE
D59	DSN1D2	DIODE
D60	DSN1D2	DIODE
K1	S51-1528-05	RELAY
K2	S51-1528-05	RELAY
L1	L40-4701-03	FERRI INDUCTOR 47UH
P1	E40-3238-05	PIN CONNECTOR 3P
P2	NO USE	
P3	E40-5068-05	PIN CONNECTOR 12P
P4	E40-3238-05	PIN CONNECTOR 3P
P5	E40-3239-05	PIN CONNECTOR 4P
P11	E40-3911-05	PIN CONNECTOR 3P
P12	E40-3911-05	PIN CONNECTOR 3P
P13	E40-3237-05	PIN CONNECTOR 2P
P14	NO USE	
P15	E40-4248-05	PIN CONNECTOR 2P
P16	E40-4248-05	PIN CONNECTOR 2P
P17	E40-3237-05	PIN CONNECTOR 2P
P18	E40-4248-05	PIN CONNECTOR 2P
P19	E40-4248-05	PIN CONNECTOR 2P
P20	E40-4248-05	PIN CONNECTOR 2P
P21	E40-4248-05	PIN CONNECTOR 2P
P31	E23-0401-05	PIN TERMINAL
P32	E23-0401-05	PIN TERMINAL
P33	E23-0401-05	PIN TERMINAL
P34	E23-0401-05	PIN TERMINAL
P35	E23-1514-05	TERMINAL
P36	E23-0401-05	PIN TERMINAL
P37	E23-0401-05	PIN TERMINAL
P38	E23-0401-05	PIN TERMINAL
P39	E23-0401-05	PIN TERMINAL
Q1	2SA1209(R,S)	TR. SI, PNP
Q2	2SC2911(R,S)	TR. SI, NPN
Q3	2SA1209(R,S)	TR. SI, PNP
Q4	2SC2911(R,S)	TR. SI, NPN
Q5	2SC1815(Y)	TR. SI, NPN
Q6	2SC1815(Y)	TR. SI, NPN
R4	RD14BB2C181J	RES. CARBON 180 5% 1/6W
R5	RD14BB2C221J	RES. CARBON 220 5% 1/6W
R6	RN14BK2C6651F	RES. METAL FILM 6.65K 1% 1/6W
R7	RN14BK2C1002F	RES. METAL FILM 10K 1% 1/6W
R8	RN14BK2C9530F	RES. METAL FILM 953 1% 1/6W
R9	RN14BK2C9530F	RES. METAL FILM 953 1% 1/6W
R10	RD14BB2C112J	RES. CARBON 1.1K 5% 1/6W
R11	RN14BK2C8200F	RES. METAL FILM 820 1% 1/6W
R12	RN14BK2C3001F	RES. METAL FILM 3K 1% 1/6W
R13	RN14BK2C1500F	RES. METAL FILM 150 1% 1/6W
R14	RD14BB2E152J	RES. CARBON 1.5K 5% 1/4W
R15	RN14BC2B3001CKW	RES. METAL FILM 3K 0.25% 1/8W
R16	RN14BC2B3001CKW	RES. METAL FILM 3K 0.25% 1/8W
R17	RN14BC2B3001CKW	RES. METAL FILM 3K 0.25% 1/8W
R18	RN14BC2B3001CKW	RES. METAL FILM 3K 0.25% 1/8W
R19	RN14BC2B1202CKW	RES. METAL FILM 12K 0.25% 1/8W
R20	RN14BC2B1202CKW	RES. METAL FILM 12K 0.25% 1/8W
R21	RN14BC2B1202CKW	RES. METAL FILM 12K 0.25% 1/8W
R22	RN14BC2B1202CKW	RES. METAL FILM 12K 0.25% 1/8W
R23	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R24	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R25	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R26	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R27	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R28	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R29	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R30	RD14BB2C103J	RES. CARBON 10K 5% 1/6W
R36	RD14BB2E152J	RES. CARBON 1.5K 5% 1/4W
R37	RD14BB2E152J	RES. CARBON 1.5K 5% 1/4W
R38	RD14BB2E152J	RES. CARBON 1.5K 5% 1/4W
R39	RD14BB2E152J	RES. CARBON 1.5K 5% 1/4W
R40	R92-1465-05	RES. NETWORK 2K,10K
R41	R92-1465-05	RES. NETWORK 2K,10K
R42	R92-1465-05	RES. NETWORK 2K,10K
R43	R92-1465-05	RES. NETWORK 2K,10K
R52	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R53	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R54	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R55	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R56	RD14BB2C512J	RES. CARBON 5.1K 5% 1/6W
R57	RD14BB2C153J	RES. CARBON 15K 5% 1/6W
R58	RD14BB2C512J	RES. CARBON 5.1K 5% 1/6W
R59	R92-1455-05	RES. CEMENT 0.47 5% 5W
R60	R92-1455-05	RES. CEMENT 0.47 5% 5W
R61	R92-1455-05	RES. CEMENT 0.47 5% 5W
R62	R92-1456-05	RES. CEMENT 1 5% 3W
R63	RD14BB2C161J	RES. CARBON 160 5% 1/6W
R64	RD14BB2C161J	RES. CARBON 160 5% 1/6W
R65	RD14BB2C181J	RES. CARBON 180 5% 1/6W
R66	RD14BB2C161J	RES. CARBON 160 5% 1/6W
R67	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R68	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R69	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R70	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R71	RD14BB2C511J	RES. CARBON 510 5% 1/6W
R72	RD14BB2C511J	RES. CARBON 510 5% 1/6W
R73	RD14BB2C511J	RES. CARBON 510 5% 1/6W
R74	RD14BB2C511J	RES. CARBON 510 5% 1/6W
R75	RN14BK2C1602F	RES. METAL FILM 16K 1% 1/6W
R76	RN14BK2C1801F	RES. METAL FILM 1.8K 1% 1/6W
R77	RN14BK2C1602F	RES. METAL FILM 16K 1% 1/6W
R78	RN14BK2C1801F	RES. METAL FILM 1.8K 1% 1/6W
R79	RN14BK2E2004F	RES. METAL FILM 2M 1% 1/4W
R80	RN14BK2E2004F	RES. METAL FILM 2M 1% 1/4W
R81	RN14BK2C1004F	RES. METAL FILM 1M 1% 1/6W
R82	RN14BK2C1004F	RES. METAL FILM 1M 1% 1/6W
R83	RD14BB2C331J	RES. CARBON 330 5% 1/6W
R84	RD14BB2C331J	RES. CARBON 330 5% 1/6W
R85	RD14BB2C331J	RES. CARBON 330 5% 1/6W
R86	RD14BB2C331J	RES. CARBON 330 5% 1/6W
R87	RD14BB2C361J	RES. CARBON 360 5% 1/6W
R88	RD14BB2C361J	RES. CARBON 360 5% 1/6W
R101	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R102	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R103	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R104	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R105	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R106	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R107	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R108	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R109	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R110	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R111	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R112	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
R113	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R114	RD14BB2E101J	RES. CARBON 100 5% 1/4W
R115	RD14DB3A561J	RES. CARBON 560 5% 1W
R116	RD14DB3A561J	RES. CARBON 560 5% 1W
R117	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R118	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R119	RD14BB2E561J	RES. CARBON 560 5% 1/4W
R120	RD14BB2C122J	RES. CARBON 1.2K 5% 1/6W
R127	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R128	R92-1061-05	JUMPING RES. ZERO OHM (5MM)
R129	RN14BK2C1101F	RES. METAL FILM 1.1K 1% 1/6W
R130	RN14BK2C1101F	RES. METAL FILM 1.1K 1% 1/6W
R131	RN14BK2C2200F	RES. METAL FILM 220 1% 1/6W
R132	RN14BK2C2200F	RES. METAL FILM 220 1% 1/6W
R133	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R134	RD14BB2C162J	RES. CARBON 1.6K 5% 1/6W
R135	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R136	RD14BB2C102J	RES. CARBON 1K 5% 1/6W
R137	RD14BB2C104J	RES. CARBON 100K 5% 1/6W
R138	RD14BB2C104J	RES. CARBON 100K 5% 1/6W
R139	RD14DB3AR51J	RES. CARBON 0.51 5% 1W
TP1	E23-0401-05	PIN TERMINAL
U1	NJM7812FA	IC,3-TERMINAL REGULATOR
U2	NJM7912FA	IC,3-TERMINAL REGULATOR
U3	NJM7805FA	IC,3-TERMINAL REGULATOR
U4	NJM4558D	IC,DUAL OP-AMP
U5	NJM072BD	IC,JFET INPUT OP AMP
U6	NJM072BD	IC,JFET INPUT OP AMP
U7	NJM072BD	IC,JFET INPUT OP AMP
U8	NJM072BD	IC,JFET INPUT OP AMP
U9	NJM4558D	IC,DUAL OP-AMP
U10	NJM4558D	IC,DUAL OP-AMP
U11	NJM4558D	IC,DUAL OP-AMP
U12	NJM4558D	IC,DUAL OP-AMP
U13	TC4094BP	IC,8-BIT SHIFT/STORE BUS REGI.
U14	TC4094BP	IC,8-BIT SHIFT/STORE BUS REGI.
U15	TC4094BP	IC,8-BIT SHIFT/STORE BUS REGI.
U16	NJM4560D	IC,OP AMP
U17	HA17012PB	IC,12-BIT D/A CONVERTER
U18	HD14052BP	IC,DUAL 4-CH ANALOG MPX/DE-MP
U19	HD14051BP	IC,8-CH ANALOG MPX/DE-MP
U20	HD14052BP	IC,DUAL 4-CH ANALOG MPX/DE-MP
U21	TLP595A	IC,PHOTO COUPLER
U22	TLP595A	IC,PHOTO COUPLER
U25	TC74HC138AP	IC,3 TO 8 LINE DECODER
U26	NJM4558D	IC,DUAL OP-AMP

PARTS LIST

REF.NO	PARTS NO	NAME & DESCRIPTION
VR1	R12-0556-05	RES. SEMI FIXED 100 B
VR2	R12-0556-05	RES. SEMI FIXED 100 B
VR3	R12-0541-05	RES. SEMI FIXED 100 B
VR4	R12-0541-05	RES. SEMI FIXED 100 B
VR5	R12-0541-05	RES. SEMI FIXED 100 B
VR6	R12-0541-05	RES. SEMI FIXED 100 B

TERMINAL UNIT

X81-2880-03

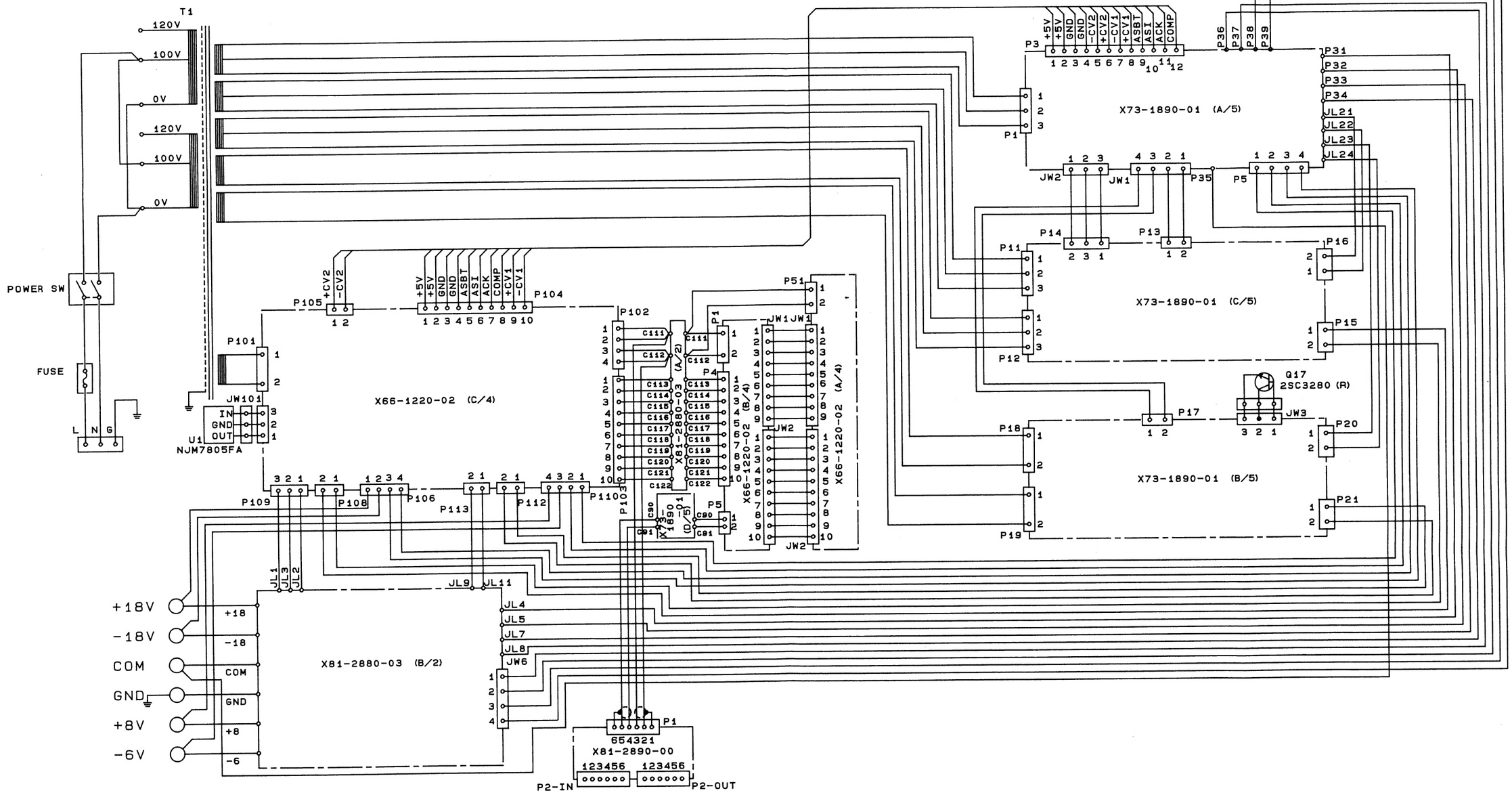
REF.NO	PARTS NO	NAME & DESCRIPTION			
	E38-0022-05	WIRE ASS'Y;P109 TO JL1,2,3			
	E38-0023-05	WIRE ASS'Y;P110 TO JL9,11			
	E38-0105-05	WIRE ASS'Y;P31-34 TO JW 4,5,7,			
	J73-0019-03	PCB (UNMOUNTED)			
C1	CE04EW1E471M	CAP. ELECTRO	470	20%	25V
C2	CE04EW1E471M	CAP. ELECTRO	470	20%	25V
C3	CE04EW1C471M	CAP. ELECTRO	470	20%	16V
C4	CE04EW1A221M	CAP. ELECTRO	220	20%	10V
C111	C91-2586-05	CAP. CERAMIC	1000P		500V
C112	C91-2586-05	CAP. CERAMIC	1000P		500V
C113	C91-2586-05	CAP. CERAMIC	1000P		500V
C114	C91-2586-05	CAP. CERAMIC	1000P		500V
C115	C91-2586-05	CAP. CERAMIC	1000P		500V
C116	C91-2586-05	CAP. CERAMIC	1000P		500V
C117	C91-2586-05	CAP. CERAMIC	1000P		500V
C118	C91-2586-05	CAP. CERAMIC	1000P		500V
C119	C91-2586-05	CAP. CERAMIC	1000P		500V
C120	C91-2586-05	CAP. CERAMIC	1000P		500V
C121	C91-2586-05	CAP. CERAMIC	1000P		500V
C122	C91-2586-05	CAP. CERAMIC	1000P		500V
R1	RD14DB3D301J	RES. CARBON	300	5%	2W
R2	RD14DB3D301J	RES. CARBON	300	5%	2W
R3	RD14BB2E561J	RES. CARBON	560	5%	1/4W
R4	R92-0150-05	JUMPING RES.	ZERO OHM(10MM)		
R5	NO USE				
R6	RD14BB2C122J	RES. CARBON	1.2K	5%	1/6W
R7	R92-1061-05	JUMPING RES.	ZERO OHM (5MM)		

BUFFER UNIT

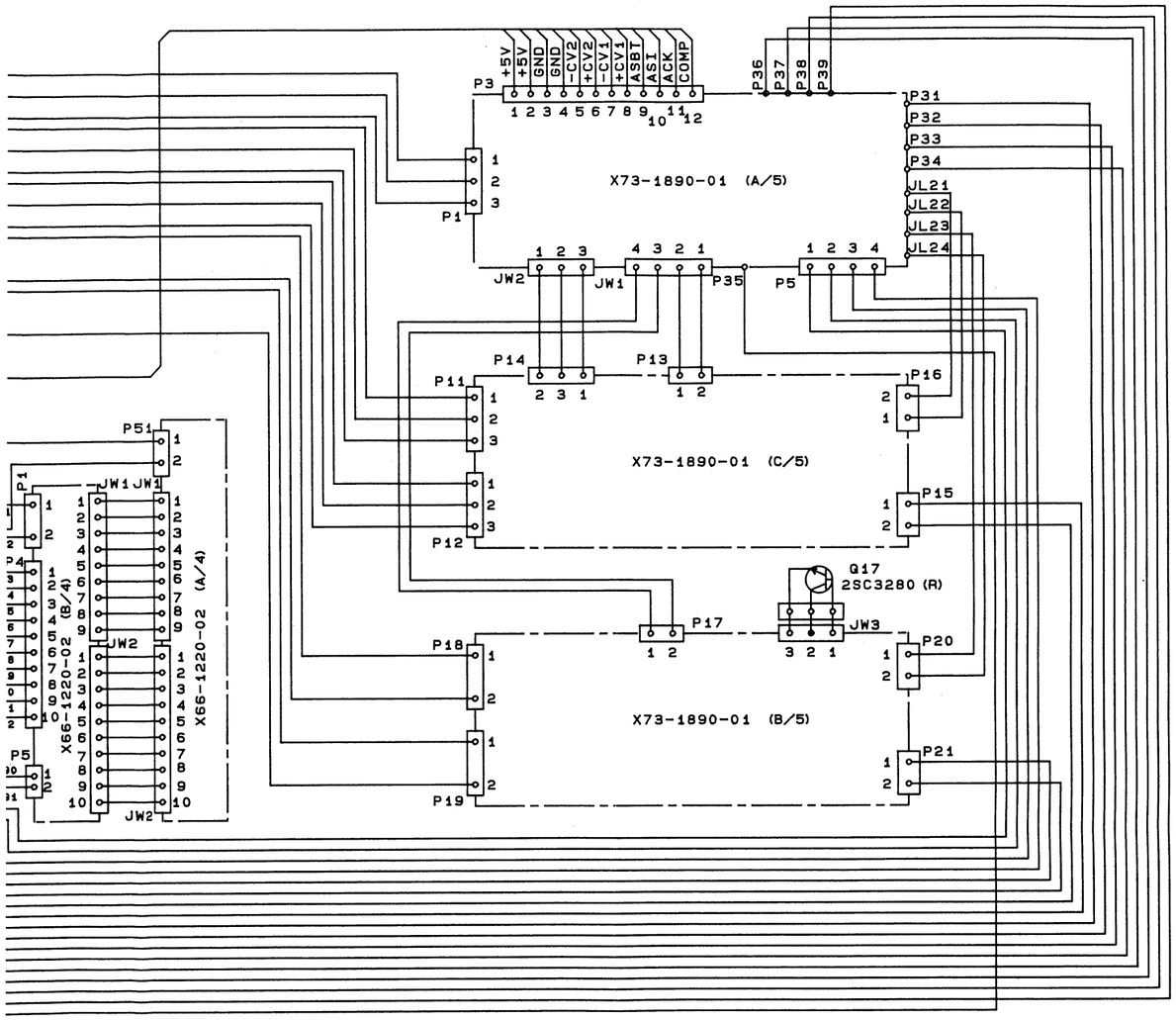
X81-2890-00

REF.NO	PARTS NO	NAME & DESCRIPTION			
	J73-0030-03	PCB (UNMOUNTED)			
C1	CE04EW1A100M	CAP. ELECTRO	10	20%	10V
C2	CE04EW1C220M	CAP. ELECTRO	22	20%	16V
C3	CE04EW1C220M	CAP. ELECTRO	22	20%	16V
C4	CE04EW1C220M	CAP. ELECTRO	22	20%	16V
C5	CE04JW1A100M	CAP. ELECTRO	10	20%	10V
C6	CE04EW1C220M	CAP. ELECTRO	22	20%	16V
D901	1SS132	DIODE			
P1	E40-3303-05	PIN CONNECTOR 6P			
P2	E58-0606-05	MODULE CONNECTOR			
Q1	2SC2785(F)	TR. SI, NPN			
R1	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R2	RD14BB2C222J	RES. CARBON	2.2K	5%	1/6W
R3	RD14BB2C472J	RES. CARBON	4.7K	5%	1/6W
U1	MAX232CPE	IC,RS-232C DRIVERS/RECEIVERS			

SCHEMATIC DIAGRAM



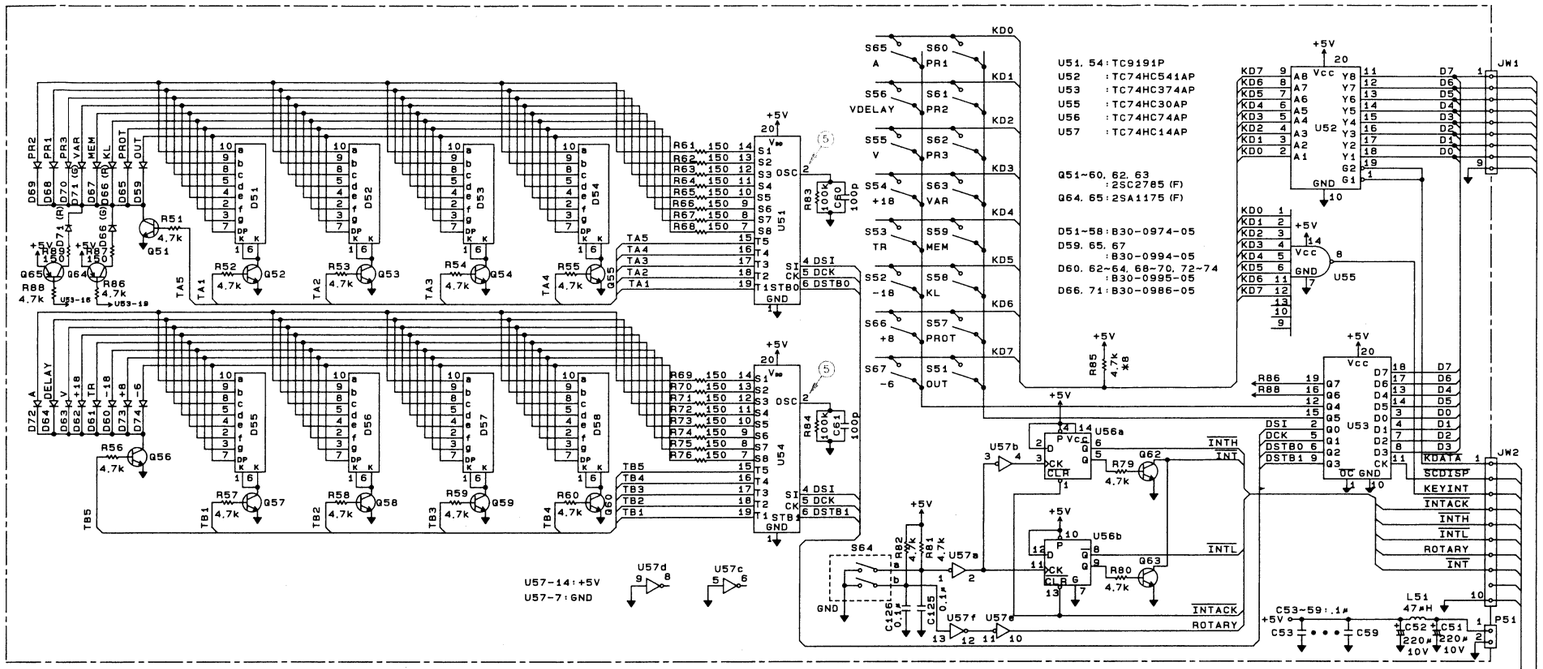
MATIC DIAGRAM



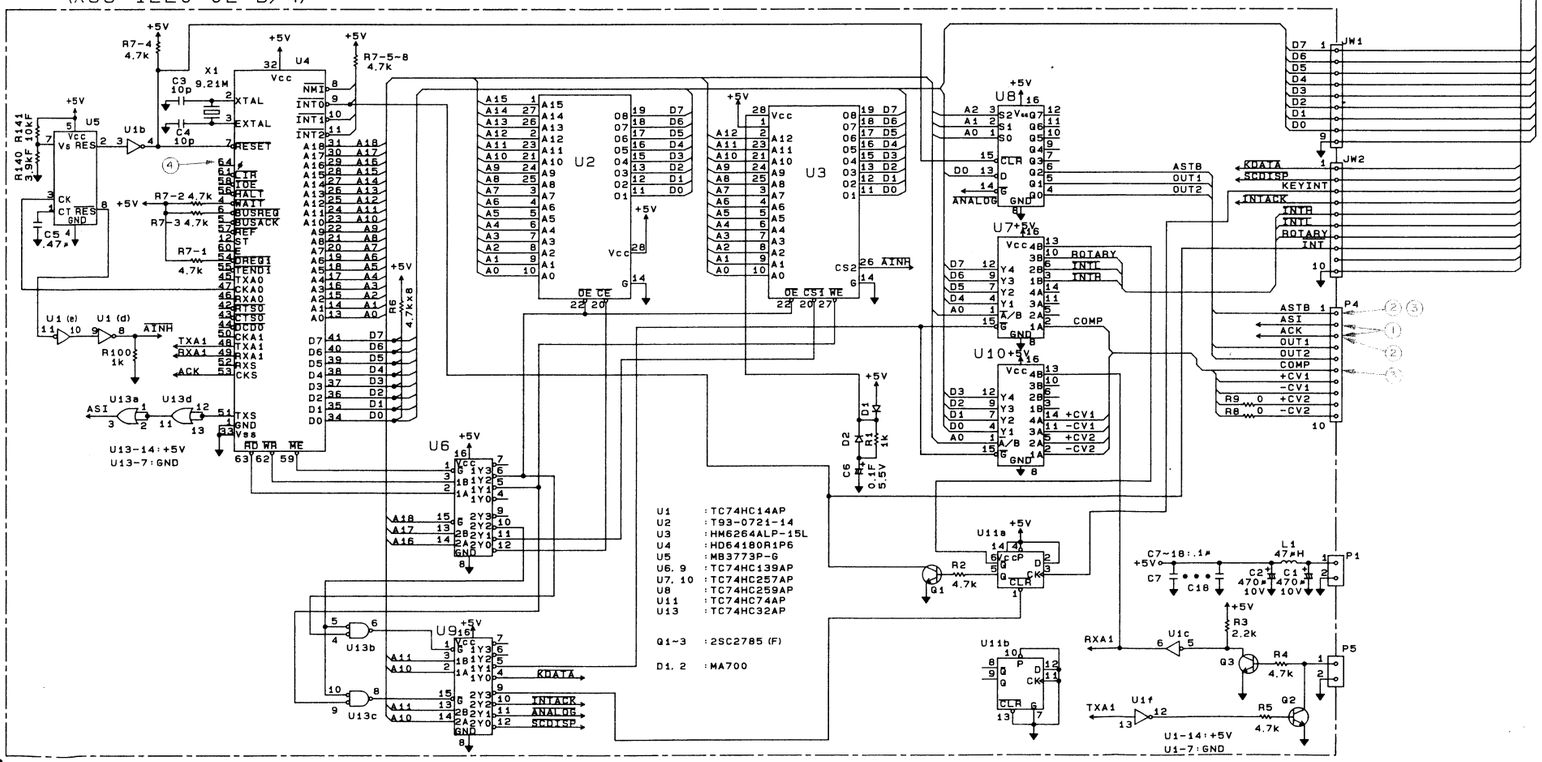
-OUT

SCHEMATIC DIAGRAM

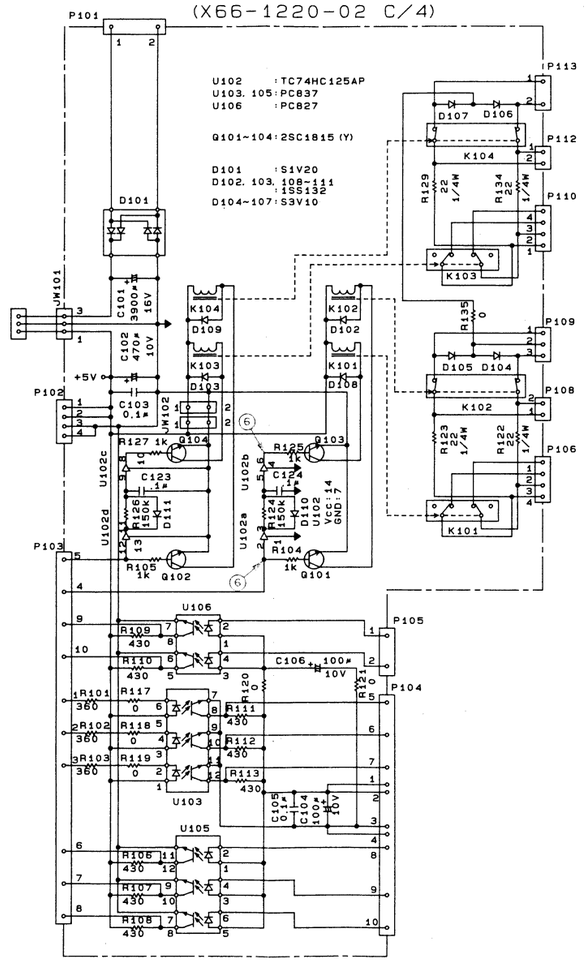
PANEL UNIT (X66-1220-02 A/4)



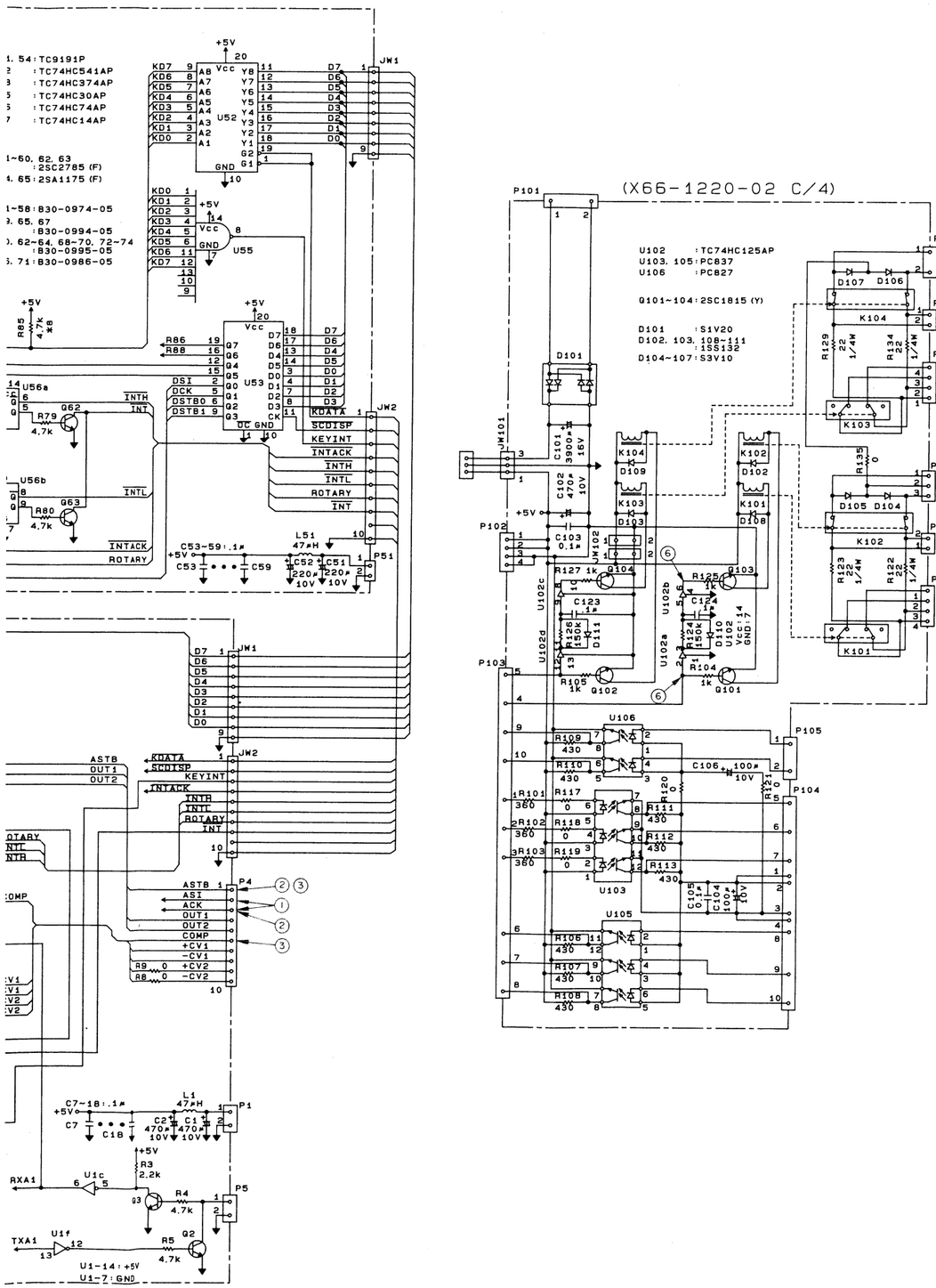
(X66-1220-02 B/4)



(X66-1220-02 C/4)

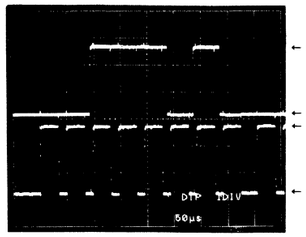


TIC DIAGRAM



WAVEFORM

①

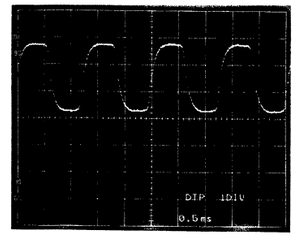


P4-2 Waveform
In case of X73-1890-01 it takes DATA Waveform.

P4-3 Waveform
In case of X73-1890-00, it takes STROBE Waveform.

50µs/diV

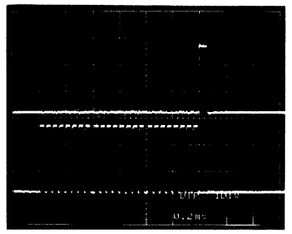
④



U4-64 Waveform, CPU Clock Waveform.

0.5ms/diV

②

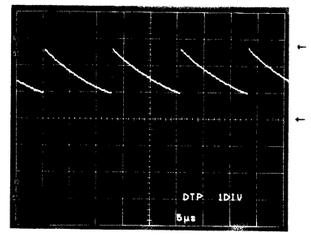


P4-1 Waveform
In case of X73-1890-01 it takes CLOCK Waveform.

P4-3 Waveform

0.2ms/diV

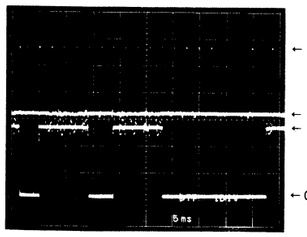
⑤



U51 and 52-2 Waveform

5µs/diV

③

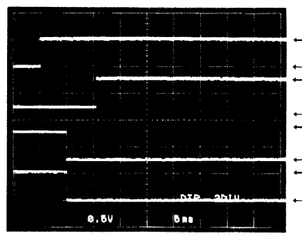


P4-1 Waveform

P4-6 Waveform
In case of X73-1890-01 it takes P20-10 Waveform.

5ms/diV

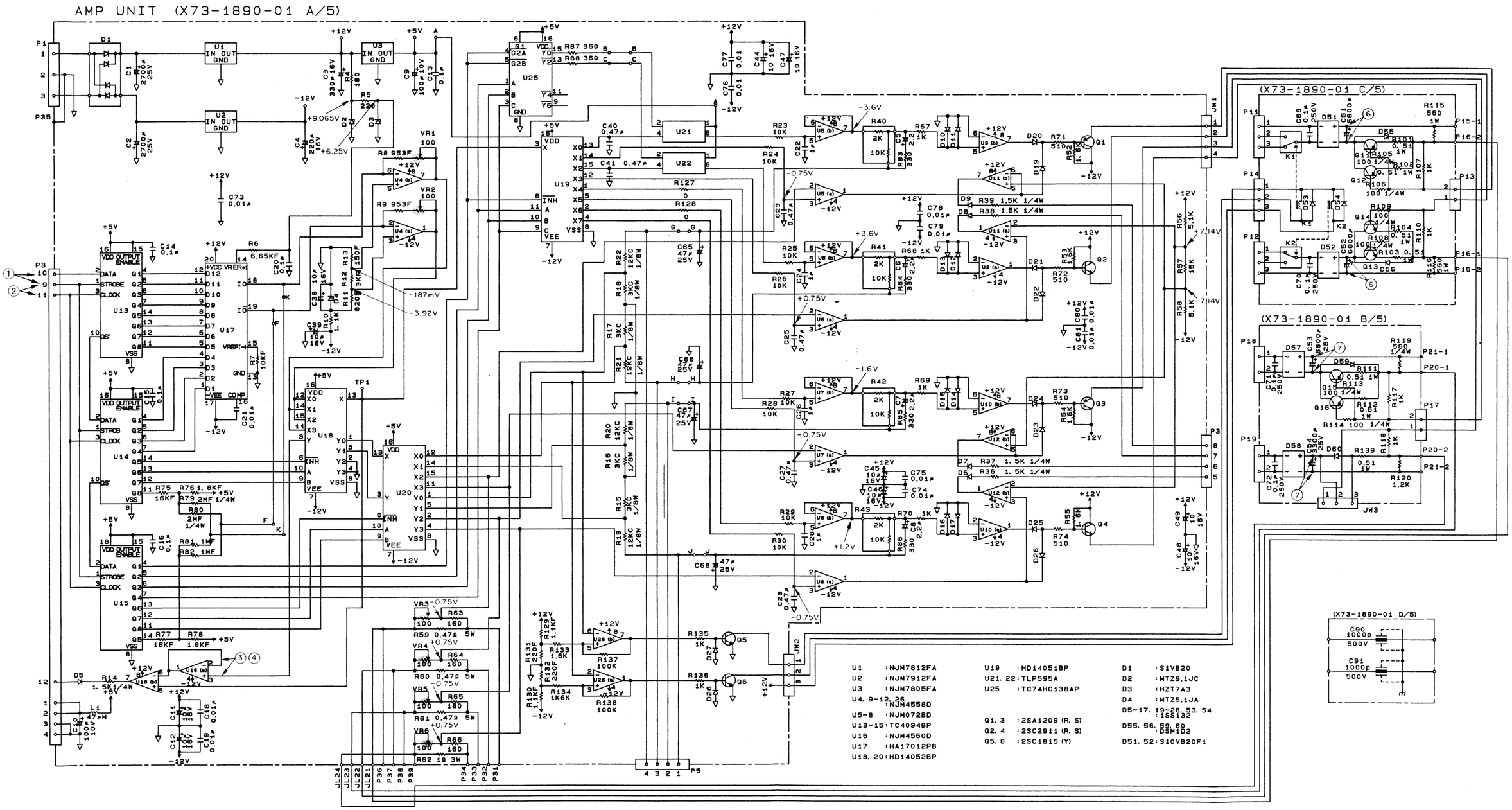
⑥



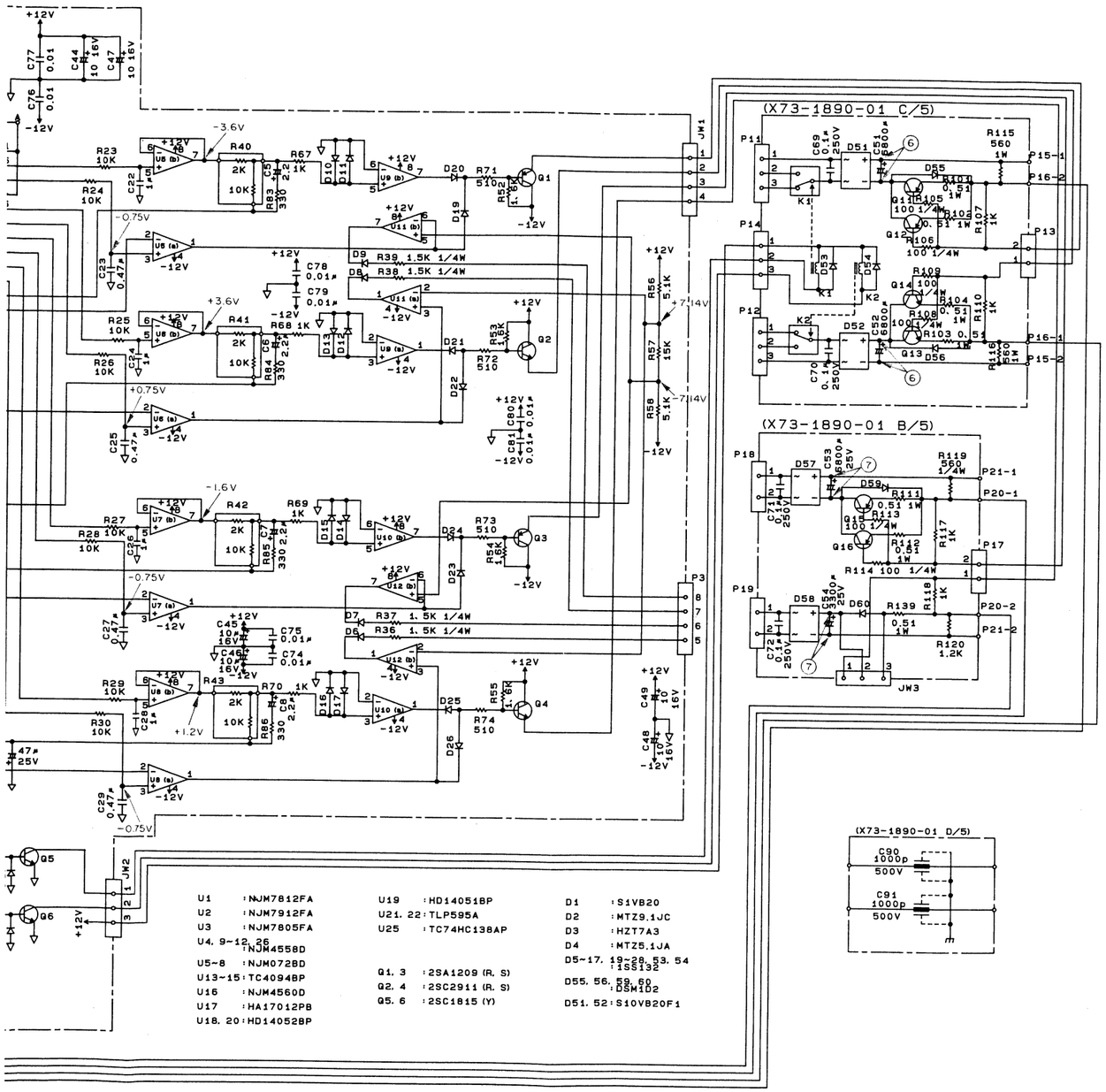
U102-2 Waveform (for K101 disturbance) — During OUTPUT is ON
U102-6 Waveform (for K102 disturbance) — During OUTPUT is ON
U102-7 Waveform (for K101 disturbance) — During OUTPUT is OFF
U102-6 Waveform (for K102 disturbance) — During OUTPUT is OFF

3V/diV, 5ms/diV

SCHEMATIC DIAGRAM



MATIC DIAGRAM



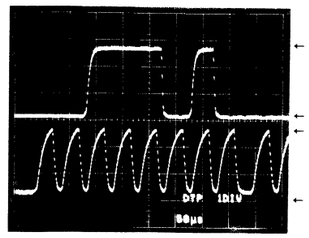
U1 : NJM7812FA
U2 : NJM7912FA
U3 : NJM7805FA
U4, 9~12, 26 : NJM4558D
U5~8 : NJM072BD
U13~15 : TC4094BP
U16 : NJM4560D
U17 : HA17012PB
U18, 20 : HD14052BP
U19 : HD14051BP
U21, 22 : TLP595A
U25 : TC74HC138AP

Q1, 3 : 2SA1209 (R, S)
Q2, 4 : 2SC2911 (R, S)
Q5, 6 : 2SC1815 (Y)

D1 : S1VB20
D2 : MTZ9.1JC
D3 : HZT7A3
D4 : MTZ5.1JA
D5~17, 19~28, 53, 54 : 1SS132
D55, 56, 59, 60 : DSM1D2
D51, 52 : S10VB20F1

WAVEFORM

①

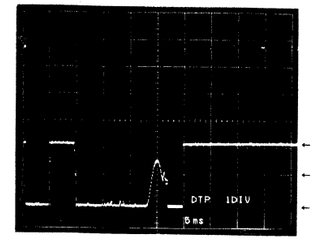


50μs/diV

P3-10 Waveform
Since it is DATA waveform, it does not always take this waveform.

P3-9 Waveform
STROBE Waveform
It sends data sent in serial forms into U3, and performs data shift.

⑤

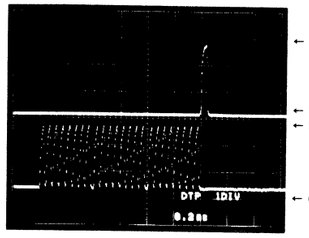


5ms/diV

Since this waveform is compared by a comparater on a serial manner, it does not always take this waveform.

U16-7 Wareform

②



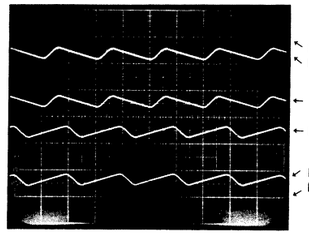
0.2ms/diV

P3-11 Waveform
CLOCK Waveform
It outputs data sent in serial forms from U3 and 4 as parallel data.

P3-9 Waveform
STROBE Waveform
Since volume of data is 24 (3×8), one set of this waveform consist of 24 pulses.

⑥

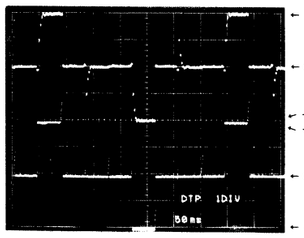
Capacitor for +18 and −18 outputs
Input: AC 100 V
Output: ±1.8 A



5V/diV, 5ms/diV

↖ Positive terminal for C52
↖ Positive terminal for C51 (when K1 is a high tap)
← Positive terminal for C51 (when K1 is a low tap)
← Negative terminal for C52 (when K2 is a low tap)
↙ Negative terminal for C52 (when K2 is a high tap)
↙ Negative terminal for C51

③



50ms/diV

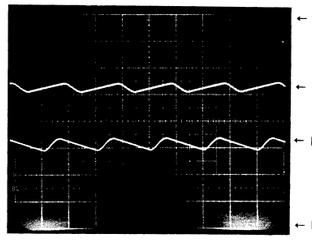
U16-3 Waveform

OUTPUT is ON.
Output voltage: Rating
Output current: OA

U16-2 Waveform

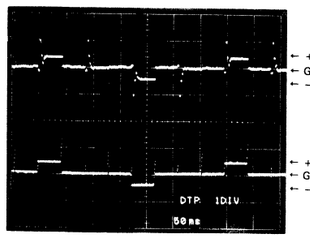
⑦

Capacitor for +8 and −6 outputs
Input: AC 100 V



← Positive terminal for C54
← Negative terminal for C54
Output: 1 A
← Positive terminal for C53
← Negative terminal for C53
Output: 2 A

④



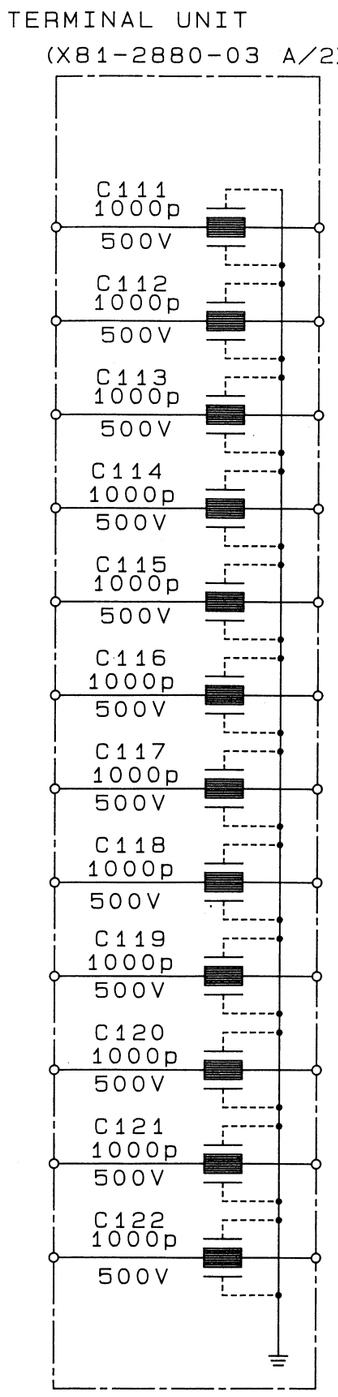
50ms/diV

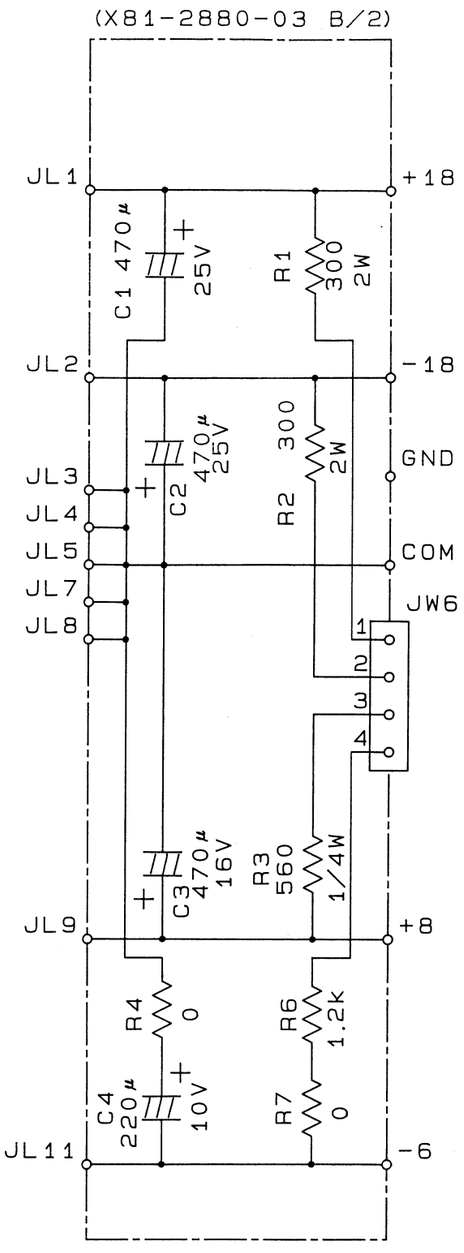
U16-3 Waveform

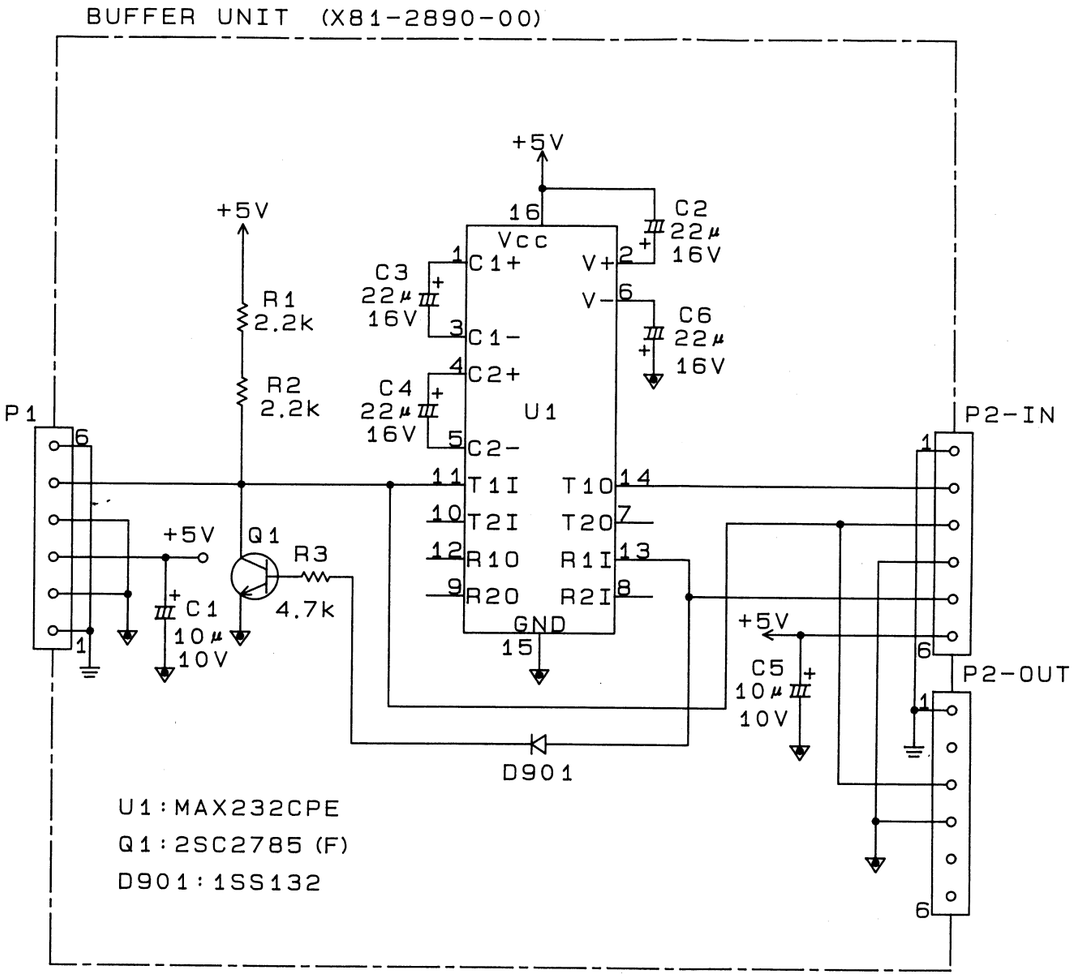
OUTPUT is ON.
Output terminal: Short-circuit
Output current: Rating

U16-2 waveform

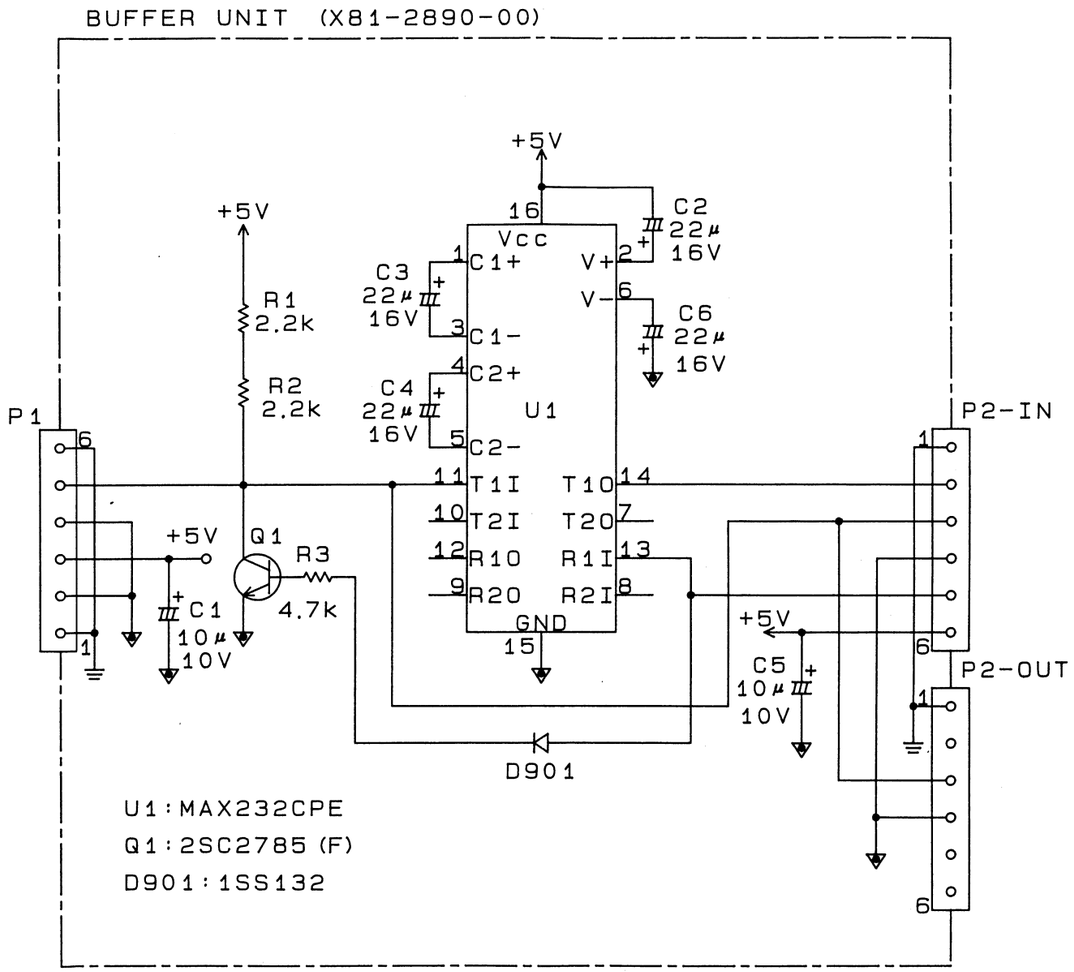
SCHEMATIC DIAGRAM







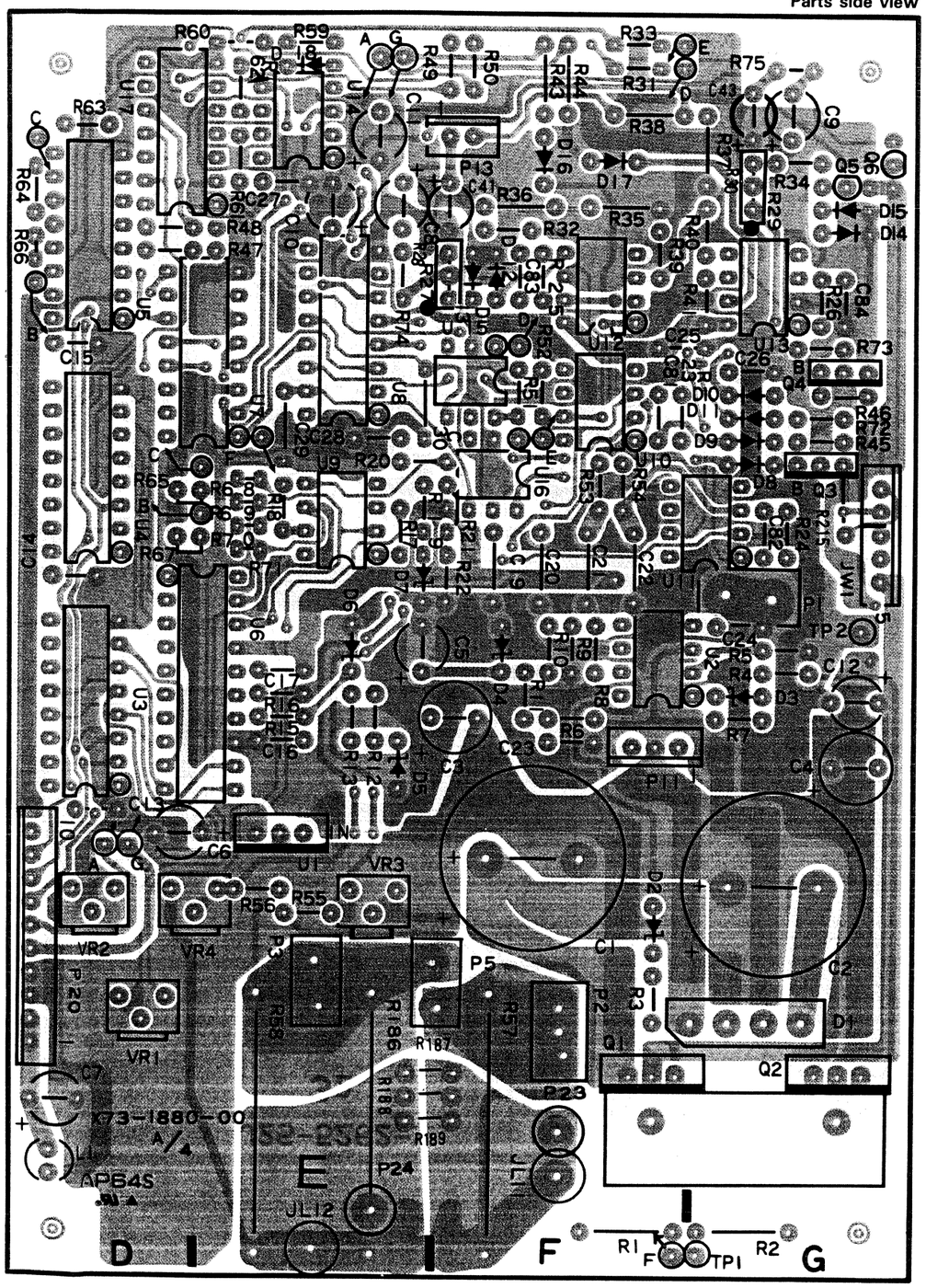
C DIAGRAM


BUFFER UNIT (X81-2890-00)
+5V
R1
2.2k
R2
2.2k
P1
6
1
+5V
C1
10μ
10V
Q1
R3
4.7k
+5V
16
Vcc
C2
22μ
16V
C3
22μ
16V
1
C1+
V+
2
V-
6
C6
22μ
16V
3
C1-
4
C2+
C4
22μ
16V
U1
5
C2-
11
T1I
T10
14
10
T2I
T20
7
12
R10
R1I
13
9
R20
R2I
8
GND
15
D901
+5V
C5
10μ
10V
P2-IN
1
6
P2-OUT
1
6
U1:MAX232CPE
Q1:2SC2785(F)
D901:1SS132

P.C. BOARD

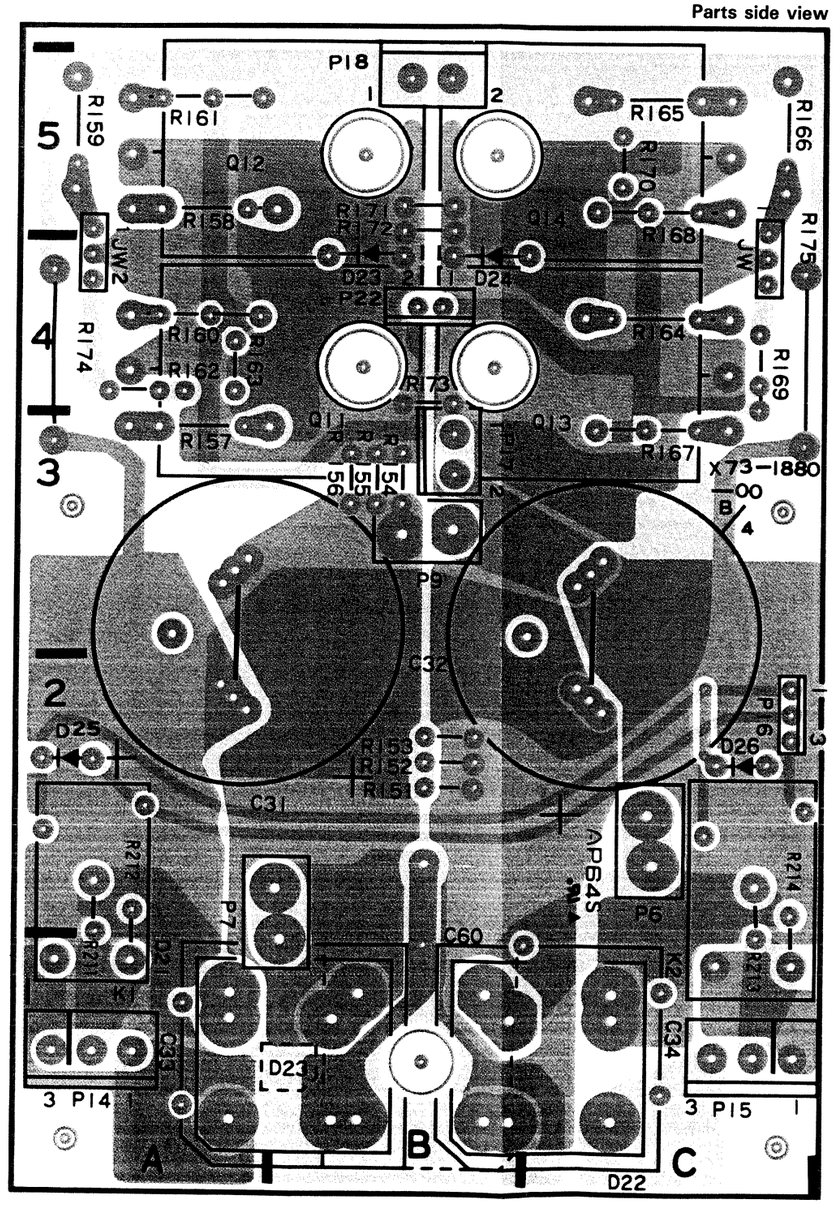
AMP UNIT (A/4)

Parts side view



AMP UNIT (B/4)

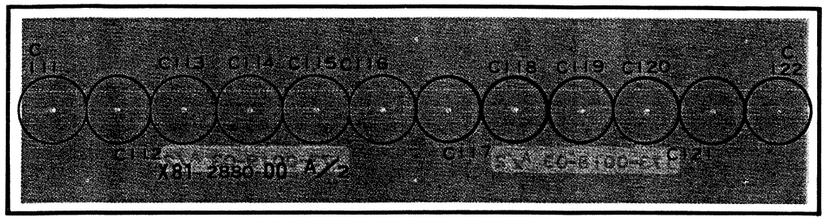
Parts side view



P.C. BOARD

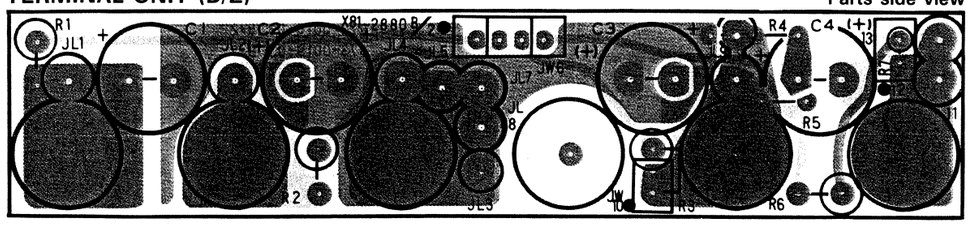
TERMINAL UNIT (A/2)

Parts side view



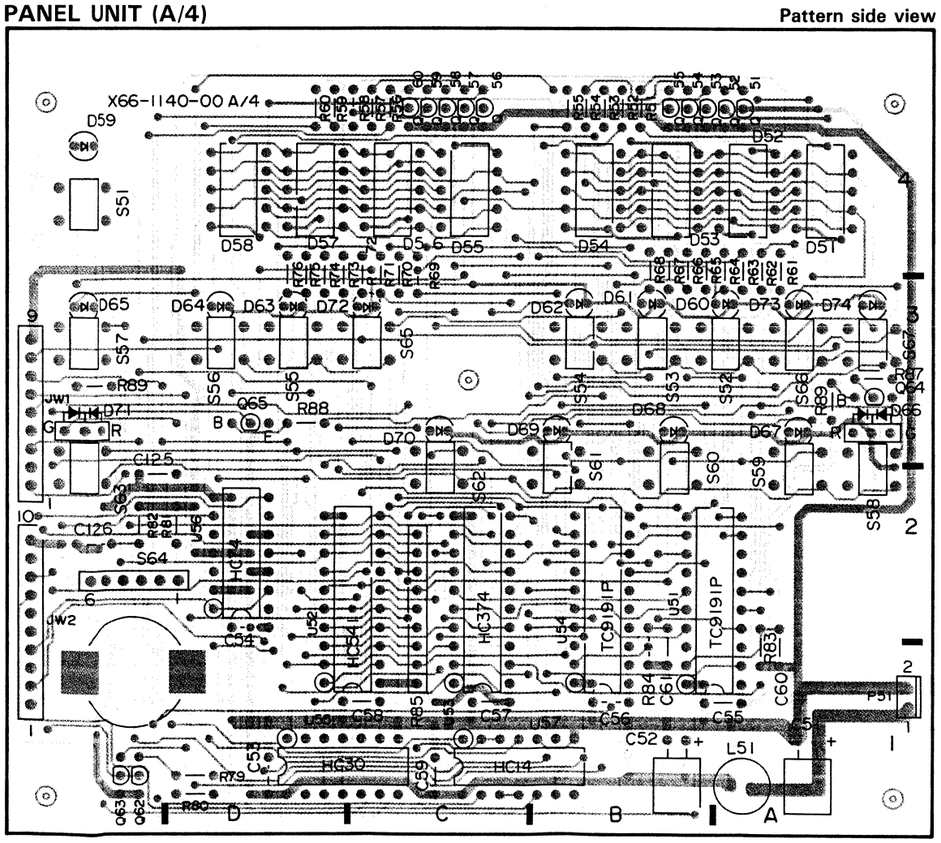
TERMINAL UNIT (B/2)

Parts side view



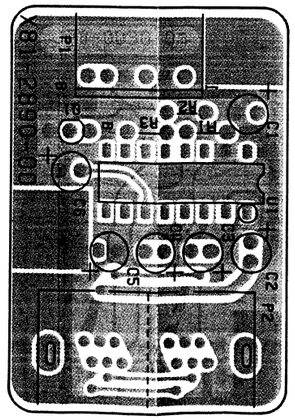
PANEL UNIT (A/4)

Pattern side view



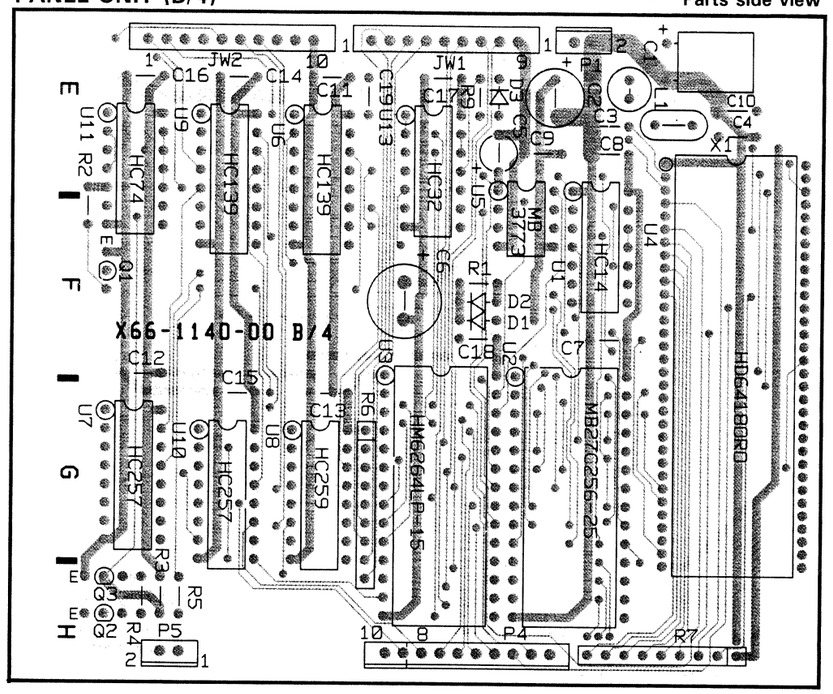
BUFFER UNIT

Pattern side view



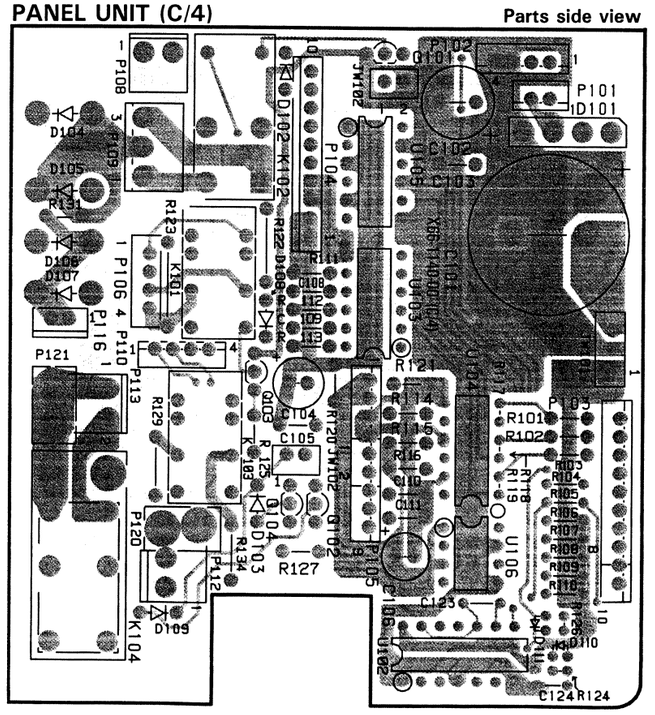
PANEL UNIT (B/4)

Parts side view

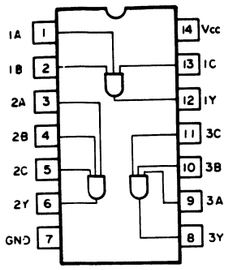


PANEL UNIT (C/4)

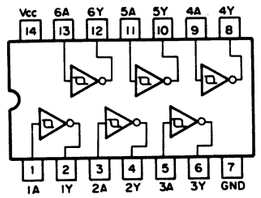
Parts side view



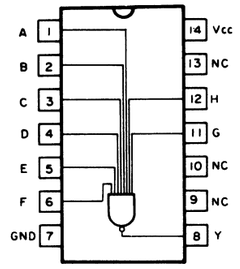
SEMICONDUCTORS



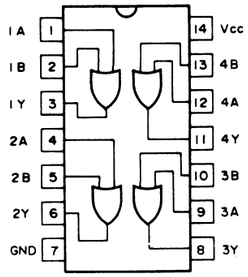
TC74HC11AP



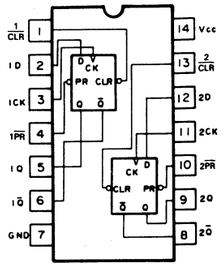
TC74HC14AP



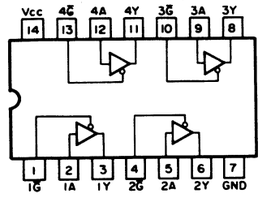
TC74HC30AP



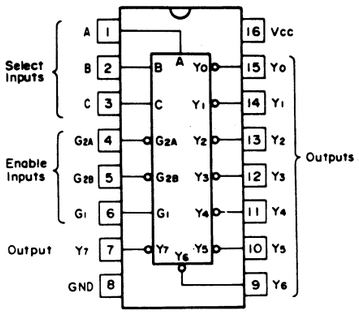
TC74HC32AP



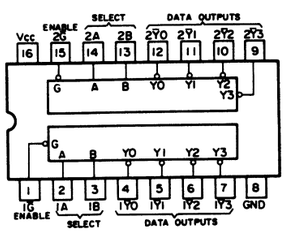
TC74HC74AP



TC74HC125AP



TC74HC138AP



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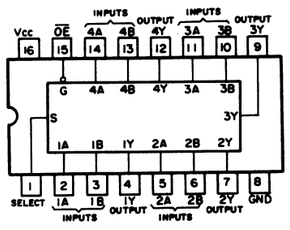

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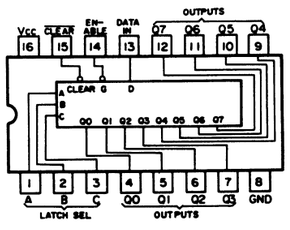

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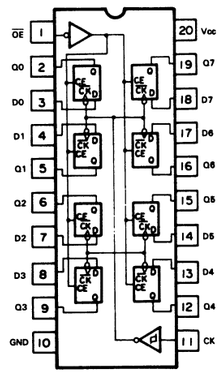

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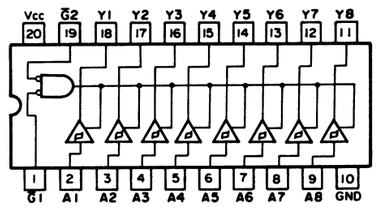

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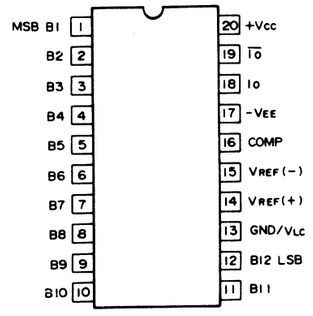

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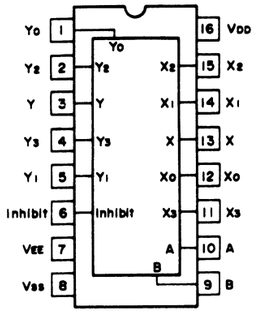

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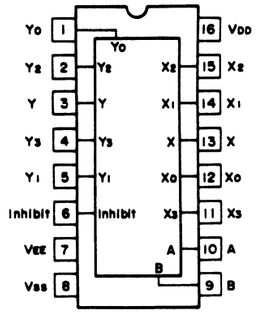

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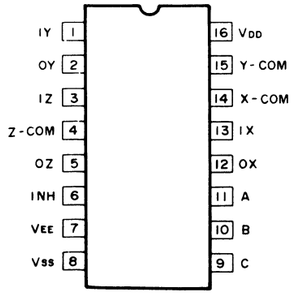

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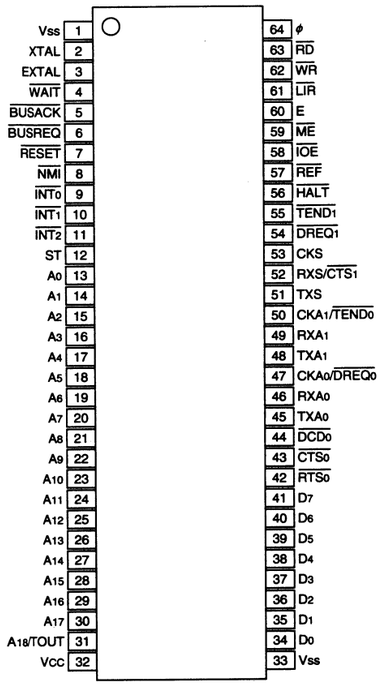
SEMICONDUCTORS



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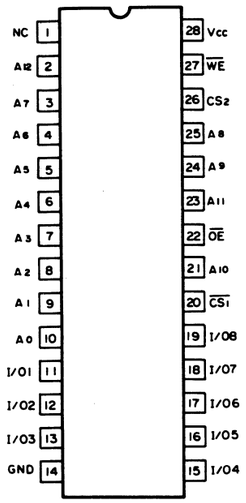

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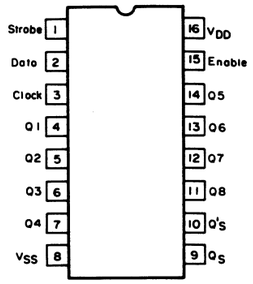

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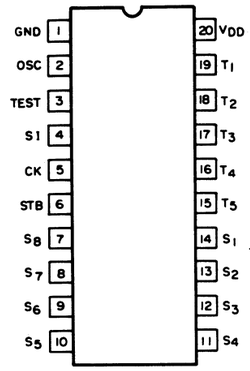

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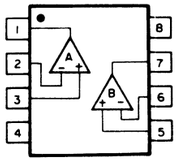
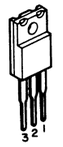


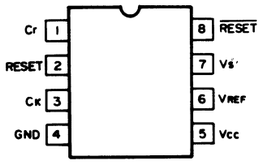
Pin name
1. A OUTPUT
2. A (–) INPUT
3. A (+) INPUT
4. V⁻
5. B (+) INPUT
6. B (–) INPUT
7. B OUTPUT
8. V⁺

NJM072BD
NJM2068D
NJM4558D
NJM4560D



1. OUT
2. GND
3. IN

NJM7805FA
NJM7812FA



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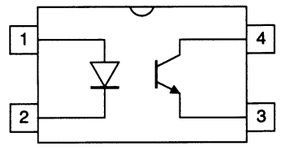
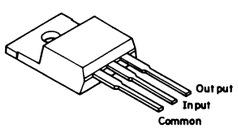


PC817



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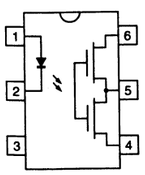

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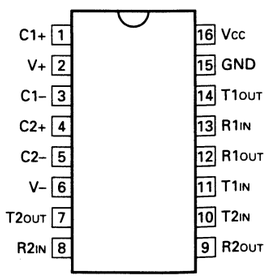
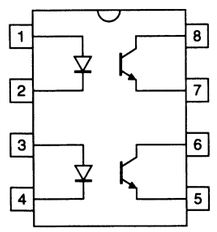


MAX232CPE



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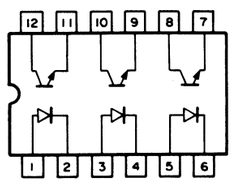
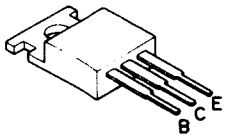


PC837

SEMICONDUCTORS



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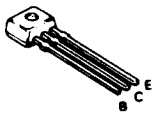

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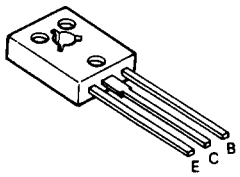

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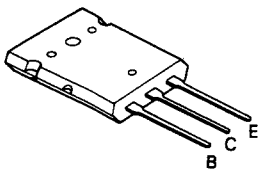
2SA1209(R, S)
2SC2911(R)
2SC2911(R, S)



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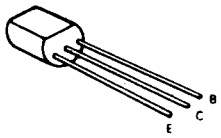

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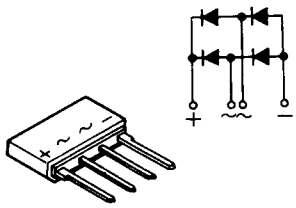
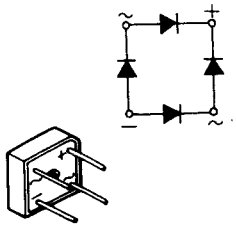


S1VB20



S4VB20
S4VB20F1
S10VB20
S10VB20F1